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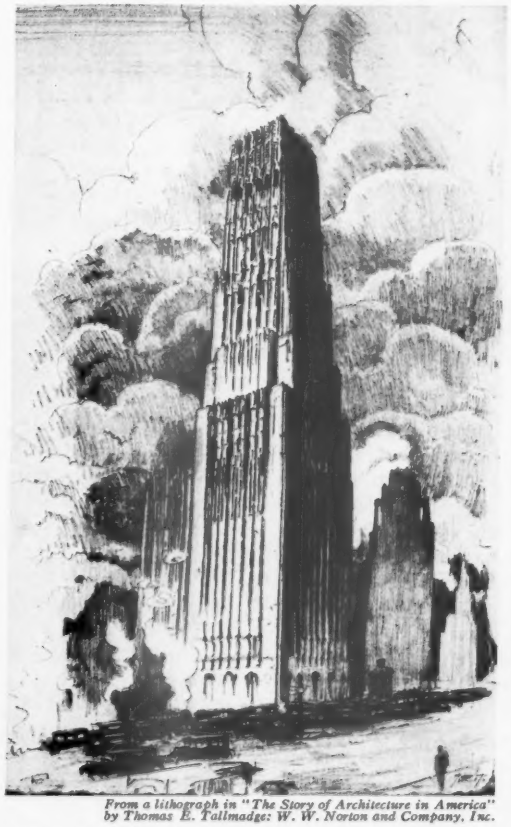
TERRACES AND TOWERS

The Evolution of the Skyscraper

BY THOMAS E. TALLMADGE

THERE are a number of truisms which, while they need not be dwelt upon, cannot be ignored in any discussion of the evolution of the American skyscraper. One of these is that the skyscraper is America's greatest gift to architecture; another is that America now leads the world in architecture. If it were not for the first truth, the second could never have been uttered. Another truth, less picturesque, perhaps, is that the period from 1886 (the birth year of the skyscraper) to the present time is far and away the most brilliant in structural engineering that the world has ever known. But to me the most interesting, the most thrilling truth is that the new era, of whose impending presence there can be no doubt and whose architectural manifestation we call "modernism," is riding into our lives on the proud shoulders of the skyscraper.

The skyscraper, and by that we mean the high building whose essential part is its structural steel skeleton, is a product of Chicago. We forget, or are too young ever to have heard, that in the years immediately clustered about the World's Fair, say from 1889 to 1900, Chicago was famous the world over as the birthplace and breeding ground of the skyscraper. Here in brilliant succession the various and essential steps were invented: the partial use of skeleton steel in the Home Insurance Building, 1884; its complete use in the Tacoma Building in 1886; the developed office plan in the Rookery, 1890; the all-terracotta building, the Rand-McNally, in 1891; the Masonic Temple, the highest building at that time in the world, 1892. The high-speed elevator owes its genesis and development to New York City, where, way back in 1859, according to Colonel Starret, it was first used in the six-story Fifth Avenue Hotel. Other efforts to lighten the loads of masonry walls were developed in New York, such as hollow tile and the cast iron front, but Father Knickerbocker looked askance at the skeleton steel building and refused to issue any building permit for such a type of structure until 1889, thereby absolving himself from any of the honor of its early development. The problem of foundations, while not vital, was obviously important, and an especially difficult one to solve for those intrepid western engineers, as Chicago is built on a stratum of muddy clay seventy feet thick. In the East one has only to bare the rock. So foundations evolved from the ordinary continuous stepped variety to the isolated footing and then to the "floating" slab of concrete and railroad iron; next, to piles, which, curiously were not used from the first; and, last, to the miscalled caissons, which are concrete columns.



From a lithograph in "The Story of Architecture in America" by Thomas E. Tallmadge: W. W. Norton and Company, Inc.

THE AUTHOR'S CONCEPTION OF ELIEL SAARINEN'S SECOND PRIZE WINNING DESIGN FOR THE CHICAGO TRIBUNE TOWER

The story and controversy of the first skyscraper has been hashed and rehashed so many

Ewing Galloway

THE CHANIN BUILDING: NEW YORK

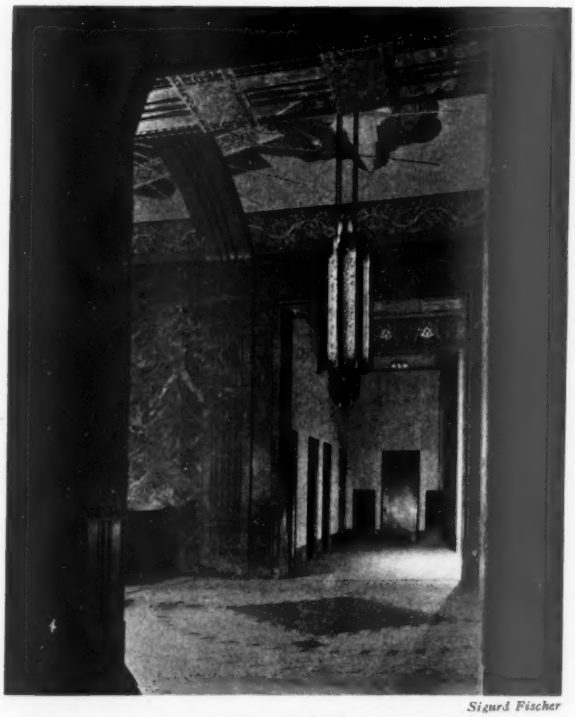
times, at least in the West, that it is no longer a *casus belli*, but it used to make the fur fly. Briefly here are the facts: in 1884 Colonel LeBaron Jenney, architect and engineer, raconteur and gourmet, started the Home Insurance Building in Chicago. In the major part of this building a true skeleton iron and steel construction is used. In 1887 the Tacoma Building, (Holabird and Roche, architects; Purdy and Henderson, engineers), was built on an exclusively steel and iron skeleton frame. Use your judgment as to which deserves the greater honor. Perhaps a precedent exists in the discovery of America, of which Mark Twain closed the subject by remarking that after Columbus discovered it, it stayed discovered!

These early skyscrapers, that is, those built before the World Fair in 1893, were of the Romanesque style, all long-legged, gawky children of Richardson's Trinity Church in Boston. After the Fair, which put the Romanesque revival out of its misery and introduced eclecticism, skyscrapers became for the most part classic in style.

The period between 1893 and the World War was a brilliant one for the engineers, but almost a disgraceful one for the architects. Thousands of skyscrapers throughout the land were built like huge ugly boxes, each with a base, shaft and cornice, and each pretending to be solid masonry and doing its best to conceal the presence of its marvelous steel skeleton within. Truly the architects feared the engineers bearing gifts. The pains and expense architects took to carry out these monstrous falsehoods are evident when one looks at classic cornices hanging by hooks, angles, and heaven knows what unless it be the force of precedent, two hundred feet above the sidewalk; at huge granite columns supporting not even themselves; at great stone façades resting on sheets of plate glass; at Parthenons and Farnese Palaces stretched up into heaven as though they were India rubber. Had the architects of the day picked on the Gothic style with its perpendicular accents, the story might have been different. Louis Sullivan, '74, pleaded, stormed, and fought in vain, and even such incarnated arguments as the Gage Building in Chicago or the Condict Building in New York City made no impression on the classicists. A devoted band of Sullivan's disciples, often called the "Chicago School," with his famous principle, "Form follows function," for a battle cry, waged a losing fight against the ravenous appetite for classicism left by the World's Fair, the influence of the Beaux Arts, and the emphasis placed upon classic architecture in our own architectural schools. In the meanwhile, Chicago had lost its preëminence gained in the invention and early development of the skyscraper, and New York, dominated by the suave genius of McKim, took the center of the stage. Soon buildings there like the Times Square, the Ivans Syndicate, the Metropolitan Tower, or even such Beaux Arts creations as the Singer Building or the Saint Regis Hotel with their picturesque silhouettes, became improvements on the corniced and flat-topped boxes erected in Chicago at the same time.

CASS GILBERT'S ('80) NEW YORK LIFE BUILDING: NEW YORK

Although illogical to the purist in many respects, the West Street Building in New York City, which won for Cass Gilbert, '80, the Gold Medal of the American Institute of Architects, brought,



Sigurd Fischer

CORRIDOR IN RALPH T. WALKER'S ('11) NEW YORK TELEPHONE COMPANY BUILDING

perhaps for the first time real beauty to the skyscraper. Another great step in advance was the Bush Terminal by Helme and Corbett. In its sheer outline almost bereft of anachronism is the prophecy of what has come to American architecture since the World War. The culmination of eclecticism came with the Woolworth Tower. Built during the years of 1911 to 1913 by Cass Gilbert, it was hailed at once as a supreme work of art. It was not, however, a complete solution of the problems of the skyscraper. It demonstrated the vast superiority, as an architectural covering of the steel skeleton, of the vertical Gothic over the horizontal Classic and the beauty of the towered skyline. Look across City Hall Park at the contemporary Municipal Building with its cornices and colonnades if you don't believe it. The trouble was that architects, in the designing of the skyscraper, had been burdened with too much liberty. Practically no limit had been placed on their height or form in New York at least, and city streets were rapidly being converted into gloomy canyons. The ribbon of sky left between them was further cut down by the crowning cornice, which had become by this time not only an absurdity, but a nuisance and menace as well. In 1916 was passed the New York zoning law, and in a few words the architectural transformation of New York City was ordained. Under what seemed at first to architects to be a disastrous limitation of their abilities, architecture in a short time emerged as a fascinating and inspiring game. As everyone knows, under the New York law you have got to keep behind a straight line drawn from the center of the street through a point 150 feet or so, depending on the locality, directly about your lot line. Chicago followed with a law that permits buildings to rise 250 feet vertically from the lot line, and above that line restricts the structure to twenty-five per cent of the ground area. So by a stroke of a pen New York becomes a city of terraces, a modern Babylon, and Chicago a city of towers, a present San Gimignano.

In 1922 the Chicago *Daily Tribune* announced an international competition for a skyscraper to house their newspaper and to provide suitable offices. They boldly stated that they hoped to build from the competitive designs the most beautiful building in America. The winning design of Howells (J. M., '90) and Hood (R. M., '03), a brilliant and beautiful thing built without curtailment of any sort, goes far toward carrying out this specification. But it is the second prize design by Eliel Saarinen, a Finn, that has become a milestone in our architectural progress. I have been accused of exaggeration in ascribing so tremendous an influence to a design that has never been built, but, as I see the skyscrapers of the new era rising to unbelievable heights and in an unknown beauty from coast to coast, I realize that the spirit of Saarinen's design animates every one. Louis Sullivan described it thus: "It is a voice resonant and rich, ringing amidst the wealth and joy of life. In utterance sublime and melodious it prophesies a time to come, and not so far away, when we shall escape the bondage and the mania of fixed ideas.

Ewing Galloway

WOOLWORTH TOWER. IN THE FOREGROUND NEW YORK CITY HALL

Ewing Galloway

CHANIN BUILDING FROM A NEARBY ROOF GARDEN

It goes freely in advance, and, with the steel frame as a thesis, displays a high science of design such as the world up to this day had neither known nor surmised. . . . Rising from the earth, it ascends to beauty lofty and serene, until its lovely crest seems at one with the sky." It's the best design since Amiens! In a word, it eliminates all cornices and horizontal accents. Vertical elements are insisted on, and are expressed by piers (covering the steel columns) which begin at the ground and rise and recede at the step-offs until they pierce the skyline. It is an expression of upward growth within a composition of rectangular masses. The ornament, although this is not so essential, is almost exclusively what we call for the lack of a better name "modernistic." As a plain matter of fact, it solved the problem of the skyscraper, a problem that architects had unsuccessfully struggled with for thirty-five years. Corbett almost guessed it in the Bush Terminal. The supreme desire for beauty led Cass Gilbert just a little off the right path in the Woolworth Tower. Bertram Goodhue might have grasped it had the Nebraska State Capitol Building been a skyscraper.

Almost over night the skyscraper was revolutionized. Raymond Hood, in the American Radiator Building, New York City, led the way. The great telephone buildings in New York City, San Francisco, and St. Louis, next, were built on the new principle. In Chicago, Holabird and Root, of the second generation of skyscraper architects, have thrown themselves enthusiastically into the new movement, and have created three inspiring buildings: 333 North Michigan, the Palmolive Building, and that of the Chicago *Daily News*. Across the street from the first of these Burnham Brothers, also of the second generation, have erected a green and gold skyscraper. Others are rising on all sides, and all, without exception, have abandoned the cornice and adopted the formula of the new era. The same story in greater extent is repeated in New York City, and Detroit is a good third. San Francisco, Los Angeles, Birmingham, and little Tulsa, modernistic to the core, follow in the train.

Ewing Galloway

RAYMOND M. HOOD'S ('03) AMERICAN RADIATOR BUILDING

Clustering around the intersection of Lexington Avenue and 42d Street, New York City, is arising a family of structural giants. The Chanin Building is fifty-six stories high, the unfinished Chrysler Building appears to be at least sixty, and the Lincoln Building dizzily towers to an almost equal altitude. These three are all modern, ultra-modern in their absence of cornices, their setbacks and their modernistic ornament, to say nothing of their structural audacities and innovations. In sharp distinction at the foot of Park Avenue arises the equally modern chronologically and protuberantly ugly Grand Central Building, returning for some mysterious reason to *ante bellum* cornices, engaged columns and the warty epidermis long since cast off by its clean and sleek sisters. In fact the best definition I have heard of the style of the modern skyscraper was given me by Gilbert Hall, the designer of the Palmolive Building, who said his building was "clean architecture," especially appropriate perhaps in that design.

Ewing Galloway

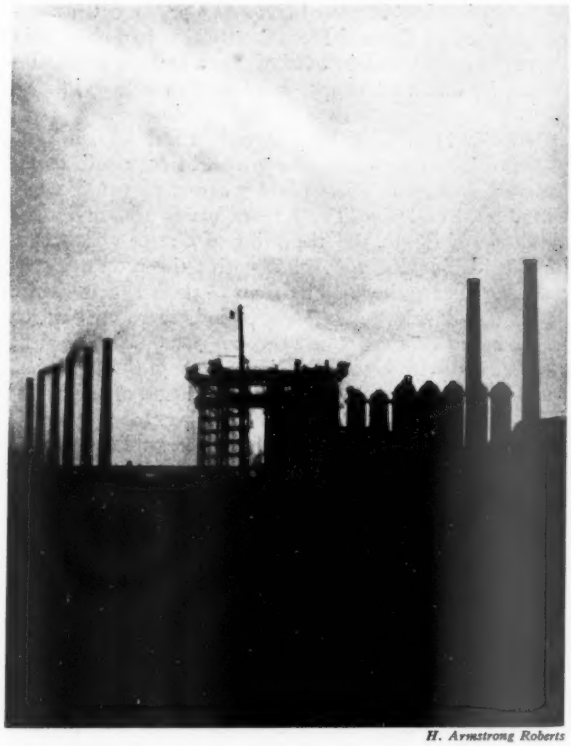
LOWER MANHATTAN FROM GOVERNOR'S ISLAND

Seventy-five stories (more or less, depending upon the value of the land) have been placed as the profitable limit to the skyscraper under present (*Continued on page 104*)

RESEARCH AND LABOR

A Chemist Looks at Modern Life

By Arthur D. Little



H. Armstrong Roberts

WE ARE LIVING in the age of science, the machine, and mass production. Like all the ages which have gone before, it is not without its contemporary critics. They would have us believe that science threatens to cause the destruction of our civilization; that the worker has become the slave of the machine; and that mass production has engulfed us in materialism, converted the craftsman into the tightener of a single bolt, and robbed the world of beauty.

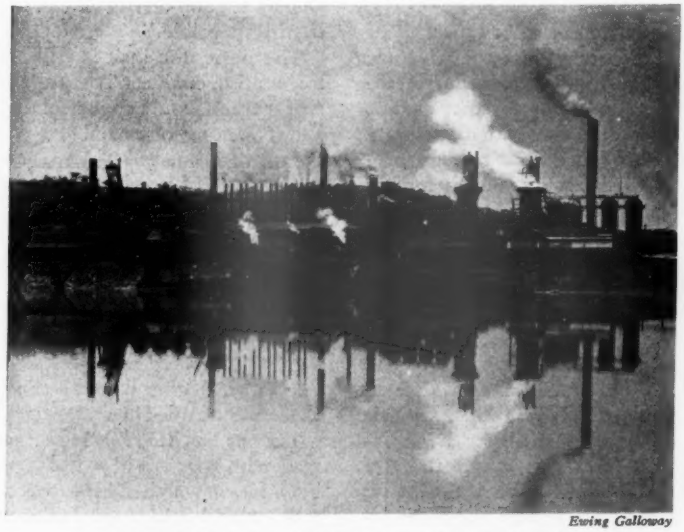
All this, if true, would be, indeed, a sorry outcome of the long series of intellectual triumphs which, during the last one hundred and fifty years, have given man so large a measure of mastery over his environment. That such ideas find currency, as they undoubtedly do, among many thoughtful and sincere persons is, in itself, a challenge to scientists and engineers. Let us consider together what, if any, justification there may be for the indictment.

Bertrand Russell, in "Icarus," says: "At present all that gives men power to indulge their collective passions is bad. That is why science threatens to cause the destruction of our civilization." In spite of its phrasing, it is obvious that Mr. Russell's charge is not against science but against humanity, and we may find comfort in the thought that, upon the whole, humanity seems to be improving. Meanwhile, science is advancing at a rate so rapid that the peoples of the earth who might otherwise indulge their collective passions will presently decline to engage in a business so vastly expensive and mutually calamitous. If philosophy and religion cannot bring peace to the world, our hope for peace is in more science.

When we pass to the second item of the indictment we find that the machine as it exists today, in all its complex manifestations, is the undoubted product of science, and that for its reaction upon our civilization science must assume a large measure of responsibility. Moreover, without the machine, mass production would be impossible. What, then, is the actual relation of the worker to the machine, and what is the relation of the machine itself to society at large?

There was published in April, in London, a magazine called *The Realist* and styled "A journal of scientific humanism." In the first issue there appeared an article by John Gibson under the title, "Has Labour to Fear Science?" I do not know to what extent Mr. Gibson, who is himself a building trade worker, is entitled to speak for others in the ranks of labor, and I cannot, of course, present his argument fairly in a few extracts from his paper. Nevertheless, I venture to quote a few sentences which must be regarded as of sinister significance if the opinions they express have any wide acceptance. Mr. Gibson says:

". . . Plainly science, its content and its method, is far beyond the reach of the great majority of Workers, and those who have gleaned the little knowledge within their reach, generally misunderstand its inten-



Ewing Galloway

SPANG CHALFORT STEEL PLANT ON THE ALLEGHENY RIVER

tions. . . . The machine with its consequent displacement of labour is hated and dreaded by the Workers. . . . The Workers do not understand why every step in the line of progress should be taken at their expense. The injustice of the thing appalls them, and they lay the blame on the most apparent cause — which is science.

"Where the Workers are sufficiently organised they will strike against the introduction of any new method or machine that is likely to cause a displacement of labour; it is one of the few things that they are really united about."

In so far as such displacement is likely to be permanent one can view this attitude of the individual worker with entire sympathy and understanding, but as a general policy it can only be disastrous to labor. Goods must be sold in a competitive market, and if by old methods they cannot be made at a price to meet the competition of the newer method, not only is the individual, but all his fellows in the industry, finally out of work.

MY FIRST LESSON in industrial economics was received one afternoon, when, as a boy, I was climbing Mount Chocorua, in New Hampshire. I came upon a berry picker who was eating a luncheon of dry bread, while beside him were several milk pails heaped with blueberries. Tactlessly, but not unnaturally, I asked him why he didn't eat the blueberries. His answer was, "I can't afford to eat them." In other words, the labor cost and consequent market value of the picked, wild blueberries in his pails were too great to permit him to consume them.

Some years later a simple tool was invented. It was little more than a dustpan, fitted in front with teeth similar to a rake, but it enabled a man to pick a bushel of blueberries in the time formerly required to pick a quart. At once the labor cost of blueberries went down. Canneries were established. Many more pickers found employment, and though they received far less per quart, their daily earnings were so greatly increased that they could have lunched on caviare sandwiches had they cared for them.

In the larger aspects of industry the same process goes on in an autocatalytic cycle. Through research we come to automatic machinery and better manufacturing methods. These result in lower costs. Lower costs permit higher wages and lower prices, both of which stimulate consumption. To meet the new demand the scale of production rises, permitting new economies, which further lower costs. To maintain mass production there must be mass buying, and mass buying is possible only with high wages.

In April, 1926, the General Electric Company issued to its stockholders a circular to tell them what their company was accomplishing in its Schenectady plant by the introduction of more automatic machinery and improved methods. In 1914 the number of workers employed was about 15,600. In 1925 it was 21,000. Their average income in dollars actually paid per week increased during this period 107 per cent, while the cost of living went up only sixty-eight per cent. Similarly, the money value of the annual product of the plant increased 179 per cent, and although the average of commodity prices had increased sixty-two per cent, the average price of all General Electric products had risen only sixteen per cent and in case of some things, as for instance, incandescent lamps, was lower than in 1914.

THERE HAVE BEEN LONG PERIODS in the world's history when otherwise brilliant civilizations based on slavery flourished and when the world's work was done by slaves. Their monuments remain in the pyramids of Egypt and the ruins of Greece and Rome. In Italy during the time of Claudius the proportion of slaves to freemen is given by Blair as three to one, while in Greece, during her greatest period, there are said to have been 12,000,000 slaves to 5,000,000 freemen. Slowly, and with many recessions through the centuries, the machine, together with some education of the heart, has brought emancipation to the worker.

In the early Middle Ages, craft workers in Europe were better off than the slaves of the Roman system, but they were serfs. Their lives were cheaply held. For the murder of a goldsmith one paid 150 sous; for that of an iron worker, fifty sous; a carpenter was appraised at forty sous, and a common laborer at thirty. Even in England as late as the eighteenth century the condition of the working population was often deplorable and precarious in the extreme. Such amelioration as at first resulted from the Industrial Revolution had, by the middle of the nineteenth century, for the most part disappeared in the factory system as then developed in England, Europe, and America, and particularly in the textile trades.

Without this background it is impossible to realize the enormous gains for which the worker in our own times is indebted to the machine. There is, it is true, little place in the Machine Age for the artisan of the old type. There is no longer much demand for the product of his laboriously acquired skill. As Usher points out: "Modern industry has its great rewards for the *man*. The introduction of machinery has not made men slaves; it has emancipated them and placed the emphasis upon the fundamental character of the individual. . . . The old distinction between the skilled and the unskilled might better be abandoned for distinction between the responsible and the irresponsible."

The jinricksha man is still slave to his machine. The locomotive engineer is master of his. What driver of a motor truck would change places with a transport coolie? What operator of a band saw would take his place in the pit to work one end of a two-man saw while blinded by the shower of sawdust? Yet riots followed the first attempts to establish power sawmills.

Who would prefer handling pig iron, pig by pig, by the strain of his own muscles, to moving tons at a time while comfortably seated in the control house of a magnetic crane? Brawn, without intelligence, can make slow progress with a spade. It takes a man to operate a steam shovel or pick up a car of coal or iron ore and dump it with a turn. Who would rather swing a sledge than feel that he controlled the mighty power of a steam hammer?

But the machine has brought mass production and the man who spends his working hours tightening a single bolt. I have watched him at work as the Ford automobile was assembled in twenty minutes, and he seemed to like the job. He wasn't merely *(Continued on page 106)*

H. Armstrong Roberts

STEAM *vs.* ELECTRICITY

The Trend toward Railroad Electrification

By Dugald C. Jackson

Editor's Note: The following article is derived from an extended paper presented last month to the World Engineering Congress, the author being chairman of the American Program Committee for that meeting. In succeeding issues The Review hopes to publish other important Engineering Congress papers.

IN CONSIDERING the applicability of electrification to American railroads, it is pertinent to review the reasons which already have led to certain installations of electrification in the United States. Without going into the details of the electrifications which have occurred and which have been described many times,* it can be stated that by far the major number of these electrifications can be ascribed to some one, or jointly one or more, of five controlling reasons:

(1) To fulfill requirements enforced on the railroads by authoritative bodies, as in certain city terminals, principally to secure relief from smoke and noise.

(2) To secure safety and comfort by eliminating smoke and deleterious gases, as in long tunnels and at city terminals.

(3) To secure reliable and efficient operation over very heavy grades.

(4) To secure more effective use of track where very heavy traffic conditions prevail, either on main lines or at terminals; and operating economies which are secured when large daily locomotive mileage can be made.

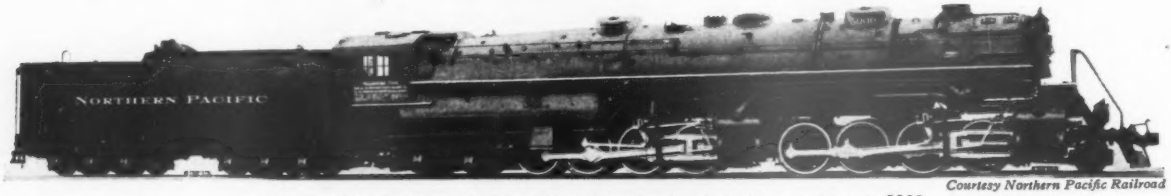
* They are summarized, up to the year 1924, in a paper by the present author presented at the First World Power Conference and entitled "Power for Transport-Railroad Electrification."

GREAT NORTHERN A.C.-D.C. MOTOR GENERATOR TYPE LOCOMOTIVE ON GENERAL ELECTRIC TEST TRACK. 260 TONS: 3000 H.P.

(5) Patronage demands, especially those of passengers.

There is no need for discussing the first reason and little need for discussing the second because the relief secured by electric operation must be evident to all who have had experience with the use of steam locomotives in long tunnels.

In considering the third and fourth reasons, involving either very heavy grades or very heavy traffic or both conjointly, it should be evident that the physical movement of trains is primarily a matter of tractive ability and that if sufficient locomotive capacity is provided, equally heavy trains can be hauled up a grade with steam or electricity and equal speed can be maintained with either type of locomotive. The relative serviceability of steam and electric traction, therefore, is primarily a matter of economic comparison.



Courtesy Northern Pacific Railroad

NORTHERN PACIFIC STEAM LOCOMOTIVE, FOUR CYLINDER SIMPLE — NUMBER 5000

The electrification of heavy grades has received very careful consideration, particularly because of slow train speeds under steam operation. It is of common recognition that electric locomotives are effective in drawing a heavy train up a steep grade, but it also should be recognized that the advantage of electrification on the trains going down the grade may be of equal importance. With electric locomotives of suitable types it is possible to control, with a minimum use of air brakes, the speed of trains on descending heavy grades by employing the electric power-regenerative feature of the locomotives.

This matter of train control in going down steep grades is one that has caused steam operators great concern over the possibility of the brakes failing to operate properly, resulting in either a runaway or a buckled and derailed train. On some heavy mountain trains, operated by steam locomotives, it has been found necessary to stop for considerable periods at various points going down hill in order to allow over-heated brakes and wheels to cool. With electric traction there are two separate means of restraining or stopping the train, *i.e.* (a) the electric power-regenerative feature which is characteristic of several types of electric locomotives, and (b) the usual automatic air brakes which are standard equipment on American railroad trains. On operating down steep grades the regenerative feature is used for controlling the train speed, a method of braking which assures that the cars remain properly "bunched," thereby promoting safety and reliability on down-hill operation. Air brakes on these trains may be reserved for use when a full stop is needed or an emergency arises.

The power regenerated from descending electric locomotives is also of value in reducing the net consumption of power for the system since the energy returned by regenerative braking of a freight train over a route with varying mountain grades may be from ten to twenty per cent of the total energy absorbed from the contact wire. The saving in brake-shoe and wheel wear also is very material, as likewise is the reduction of general wear and tear on rolling stock and track.

America has a number of examples where increased train weights on heavy up grades have been hauled at faster speeds by changing from steam locomotive operation to electric locomotive operation, but the extra tonnage and speed obviously have been accomplished by putting a larger amount of effective locomotive horsepower on the electrically operated trains than previously existed on the steam operated trains. In each instance where such results are desirable, careful consideration should be given to the cost and practicability of accomplishing the same result in tonnage and speed by providing an equivalent and available horsepower capacity in properly proportioned modern steam locomotives, and comparing the same with the cost and practicability when using electric locomotives. Whenever steam locomotives are employed for such service it is important that adequate engine capacity be used so that sufficient speed can be maintained; otherwise the locomotive boiler and cylinder capacity is not being fully utilized. There is still a difference of opinion among American engineers regarding the relative superiority of steam and electric locomotives for use where the trains are heavy and the grades stiff, but it is demonstrable that there are many such situations in which electric locomotives correctly chosen are sure to prove the more satisfactory.

A heavy grade section on a railroad may be of a relatively short length, and much less in length than a normal engine division even for steam operation (engine divisions for electric operation may be made much longer than for steam operation) so that the same locomotive normally operates over a varying grade, thus requiring a varying amount of tractive effort. It is evident from the torque-speed characteristics of the two types of locomotives that with many combinations of grades which may occur, a steam locomotive could operate at maximum horsepower over a more extended portion of the route than an electric locomotive of the same maximum rating, and thus make better time; unless the traffic is sufficient to make it desirable to haul heavier trains than can be satisfactorily hauled by one maximum steam locomotive having the desired speed possibilities, in which case a single or multiple cab electric engine may be preferable to two steam engines.

All of these factors need careful analysis and consideration where steam traffic already exists, and replacing the steam motive power by electric motive power is under consideration. In situations where new

motive power must be secured in any event, either of steam power or of electric power, for betterment of conditions or because the line is new, the economic conditions look more favorably toward electrification, even when good steam motive power is already on the ground available in sufficient amount.

Very dense traffic conditions are fundamentally favorable to electrification, and this is notably true in situations where freight and passenger traffic of widely diverse speeds are approaching the limit of track capacity for steam operation with existing steam motive power, since the movement of the heavy slow trains at a faster speed over the route may be accomplished more readily by using electric motive power than by using steam motive power. This is true whether the route involves serious grades or is of moderate rolling gradients. Moreover, in crowded passenger terminals, the use of multiple-unit electric trains relieves congestion by eliminating the idle engine movements associated with switching where steam motive power is used for such trains. The stress of traffic density seems likely to dictate the installation of electrification on some important routes and in additional passenger terminals in the United States, where other conditions might yet be suitable for efficient use of steam motive power.

Electrification involves investment in fixed plant items for the electrical converting and conducting system, which has no counterpart in the investment associated with equipping a railroad for steam power operation. As the amount of this investment is not a direct function of the amount of traffic, it is obvious that electrification may be an economic success on a railroad of dense traffic although for a railroad of sparse traffic it might be an economic failure.

Certain of the two, three, and four track main lines of railroads in the eastern part of the United States have reached such a state of traffic density on the tracks that relief is needed. This may be secured by adding an additional track or additional tracks to the route, or by building an alternative route, either of which improvements is likely to be very costly to accomplish in a thickly populated region such as that part of the United States which lies east of the Appalachian Mountains and north of the Potomac River. Such improvements also may be exorbitantly costly in a mountainous region where the problems of gradients and curvature are difficult to solve on standards reasonably comporting with heavy traffic. Relief may be secured also by consolidating trains into longer units and reducing the disparity between the speeds of the different classes of trains in the freight and passenger service. This latter relief may be gained by means of electrification, using multiple cab locomotives with unit control for freight trains and the heaviest passenger trains, single cab locomotives for intermediate trains, and trains of multiple unit electric cars for local passenger service if such exists in important amount, thereby reducing the diversity of time occupied by the trains for traveling over the route. By such means enhancement of the transportation capacity of the existing tracks may be secured and the larger investment required for additional tracks be correspondingly postponed. It is estimated that from ten to twenty per cent can be added by this means to the capacity of a two-track route of moderate gradients which carries the widely diverse traffic composed of several classes of trains of differing scheduled speeds characteristic of American trunk line railroads. Where grades are very heavy the improvement is larger, and where suburban service is controlling it may be as much as twice as great as the figures named.

There are certain items of operating expense which experience has shown ordinarily to be definitely less for electric operation than for steam operation; particularly the item of locomotive maintenance per engine-mile, which for electric locomotives of general type with direct-current motors may be in the order of seventy per cent less than for steam locomotives of equal tractive capacity; the item of fuel which may be in the order of thirty to seventy per cent less; the item of track maintenance which is freed from the effect of dynamic augment and nosing characteristic of steam freight engines; and the item of locomotive water supply, which is difficult to secure in some parts of the country. By consolidating trains and providing multiple-cab electric locomotives of greater power combined with more speed than is available in steam engines, the cost of train crews per gross ton hauled may also be reduced.

Courtesy Pennsylvania Railroad

PENNSYLVANIA TYPE FF-1 ELECTRIC

A further return may be expected to come from reduced divisional operating expenses, in some cases from increased rates of fare for passenger traffic, and in the case of terminals in large cities in notable values established for commercial building sites over the stations and train yards.

The complete economic consideration of a contemplated electrification of a railroad which has been and is using steam motive power of good quality, is far from a simple matter. A competent engineer can without difficulty estimate the new money (*Continued on page 114*)

Underwood and Underwood

ABOVE: CORNER OF NEW YORK NEWS ROOM OF THE ASSOCIATED PRESS. NOTE VARIETIES OF TRANSMISSION DEVICES. OVAL: KENT COOPER; GENERAL MANAGER OF THE ASSOCIATED PRESS

SCIENCE AND

Modern Newspaperdom Owes Its Further Technical Achieve

BY JOHN J.

FOR news, that most perishable of commodities, public thirst can be palliated but never quenched. Its bounds are constantly widening; it knows no seasonal fluctuations; it was never more important than it is today. Nothing is older than last night's newspaper and myriads of correspondents are relentlessly engaged in a pursuit to regather anew the intelligence of the world, swiftly and completely — and accurately. Modern newspaperdom does its thinking in terms of today. Tomorrow it may consider, for tomorrow is news in the making: yesterday is gone, useful merely as a background for facts of the moment. Science is responsible, for science has brought about this situation and technical achievement maintains the seemingly impossible, as the possible.

The newspaper, as we know it, was distinctly American in its origin and development. In Colonial days journalism was a leisurely process, an era of personalities when the vehemently expressed views of the editor were the chief distinction of a paper. Material for the news columns brought by sailing ships or couriers was welcomed weeks or even months after the events took place. Type was laboriously set by hand and presswork was equally slow as compared to modern standards. In fact, until the 1840's conditions resembled those of the days of George Washington. He, for example, was notified by courier of his election some weeks after the balloting, and had occupied the Presidency practically a year before the complete count of the election returns had been compiled.

In the 1840's, however, a new era opened with Morse's invention of the telegraph and the perfection of the rotary press by Hoe. Upon the foundation they created has been erected the modern news-gathering and newspaper manufacturing structure which made it possible to collect and publish tabulated results of Mr. Hoover's victory less than six hours after the last polls closed. The chronology of this progress is a succession of

RECEIVING NEWS BY TELEGRAPH, A METHOD NOW PRACTICALLY OBSOLETE

Price

THE FRONT PAGE

Development to Science and on ments Its Future Depends

ROWLANDS

Nicholas Murray

ABOVE: NEW YORK NEWS ROOM OF THE UNITED PRESS. TELEPHONE PRINTERS ARE ON THE LEFT. OVAL: KARL A. BICKEL, PRESIDENT OF THE UNITED PRESS

technical achievements, significant in a consideration of what further heights may be attained. A brief review of these achievements is impressive.

Professor Morse completed his apparatus in 1838 and demonstrated its practicability by completing, with the aid of a Congressional appropriation, the first long distance line between Washington and Baltimore in June, 1844. Later it was extended to New York. This line the elder Bennett employed for his *Herald* as early as May, 1846, to relay news of the Mexican War brought by courier to Washington. Thereafter the news content of all papers, for the *Herald's* rivals soon fell in line, took on an aspect of timeliness hitherto lacking. Within ten years it was possible to communicate by telegraph with nearly every section of the United States except the Far West.

NEW AUTOMATIC PRINTER FOR RECEIVING STOCK MARKET REPORTS

The first submarine cable linked England with the Continent under the Straits of Dover in 1851. Cyrus W. Field began laying the first transatlantic cable between Valencia, Ireland, and Trinity Bay, Newfoundland, in 1858 and, on August 16 of that year, the first faint signals came across, a greeting from Queen Victoria to President Buchanan. In all 732 messages passed over Field's cable and then it broke. Eight years later, in July, 1866, a new cable was laid and it came into permanent use. By 1872 America and Europe were served by four cables and, by 1888, more than 100,000 miles of underseas circuit were available. Today there are only 261,000 miles under the seven seas but a cable's capacity has meanwhile been increased over 200 fold. Victoria's historic message of ninety words required sixty-seven minutes for transmission while modern automatic transmitters, which have replaced the manual sending methods, now shoot messages at 300 words per minute.

The first telephone conversation took place March 10, 1876, and soon Alexander Graham Bell constructed the

ABOVE: TRANSMITTING NEWS DISPATCHES BY PRINTER TELEGRAPH AS DESCRIBED IN TEXT. RIGHT: RECEIVING NEWS IN THE RADIO DEPARTMENT OF THE NEW YORK "TIMES"

first telephone line between Boston and Cambridge, but it was years before this method of communication was adopted for general news work. Now long distance coverage of news events by telephone is routine and nearly half of local news on large dailies is received by rewrite men from staff reporter by telephone. The first transcontinental telephone circuit, reaching from the Atlantic to the Pacific, was completed by the American Telephone and Telegraph Company in 1914, marking the most important stage in long distance telephony. In addition to gathering news, the press associations employ the telephone for transmission of "pony reports" or short period news service to small dailies and country newspapers.

Concomitantly with the expansion of world channels of communication attention was inevitably directed to the need for improvement in the mechanical departments of the newspaper. Larger and faster presses with a speeding-up in typesetting methods were needed if the benefit of cable and telegraph were to be fully realized.

The London *Times* was one of the first great papers of the world to encourage the development of press room machinery. In 1845 Richard M. Hoe of New York built a revolving type printing machine for the *Times*, and, in 1846, produced the rotary, his "Lightning Press," propelled by steam, the type being imposed in curved "turtles" upon a horizontal cylinder which, in revolving, came in contact with other cylinders carrying the white paper. William A. Bullock, publisher of a newspaper in Philadelphia, made the invention of the first press to print from a continuous web of paper. This "perfecting press" came into being in 1865. Luther C. Crowell, a Cape Cod fisherman with rare mechanical talents, produced in the early 1880's a folding device for presses which up to that time had been capable only of delivering uncollated sheets, and Joseph Pulitzer was the first publisher to install one of Mr. Crowell's machines in the office of the St. Louis *Post-Dispatch*. Mr. Pulitzer was nearly demented by its vagaries and the experience set him temporarily against further "experiments," but in time the Crowell attachment became a success delivering a neat half-page fold, up to eight pages. Later the invention was expanded so as to produce the familiar quadruple machine, the base of all the monsters of today.

Newspaperdom's modern favorite, the complex double octuple rotary press, has a production speed of nearly 70,000 papers of thirty-two pages per hour. It prints, cuts, folds and counts that number of copies at the touch of a button. By reducing the size of the paper to sixteen pages production is raised to 100,000 copies per hour and this latter figure can be doubled in running an eight-page edition.

The perfection of the linotype, an invention of Ottmar Mergenthaler, of Baltimore, in 1886, effected a revolution in the printing art in that it substituted the line instead of the letter as the unit of composition. Besides being speedier, it dispensed with the necessity of purchasing, composing and distributing type. Many machines, some giving excellent results, had preceded it (the first automatic type-casting machine was probably that which David Brewster of Bordentown, N. J., patented in 1838) but the reliability of Mergenthaler's machine and the wise management of organization building it gave it a commanding lead after its first tryout by the old New York *Tribune*. Today "linos" are to be found in the composing rooms of virtually every large newspaper in the world.

Subsidiary advances also contributed to speedier as well as more economical production of newspapers. Until 1829, when M. Genoud of Lyons, France, adopted papier-maché, wax and clay had been employed for stereotype matrices. Charles Craske, a New York engraver, introduced in this country the papier-maché method in 1854 when he made the first curved stereotype plate for a rotary press in the office of the New York *Herald*. It was not yet possible, however, to multiply the number of plates indefinitely.

Illustrations for daily newspapers came into use in a limited way about 1870, but there were no fast methods of reproduction. In 1878 the photographic half-tone was invented by Frederick E. Ives of Cornell University. Three years later he greatly improved it and adapted it to newspaper work where it rapidly superseded the wood engraving method. By 1886 Mr. Ives had invented the cross-line screen which is still in general use.

In the course of the Nineteenth Century two circumstances gave great impetus to papermaking, an art which, up to 1800, had not been improved to any material extent since the Middle Ages. First, a mechanical method of making paper in a continuous web, instead of by hand in sheets, was found when a Frenchman, named Roberts, invented the Fourdrinier machine. Second, a substitute for rags as the chief constituent was found in wood fibre. In 1867 a machine invented by Herman Voelter of Germany for grinding wood pulp was especially imported and mechanically ground pulp was first produced in this country that year at Stockbridge, Mass. The output was about a half ton daily; it sold for eight cents a pound, being pressed into cakes by hand and shipped in barrels to a paper mill. Chemical processes for manufacturing wood pulp came almost contemporaneously with that of making ground wood. The soda process was patented by Hugh Burgess in the United States in 1854; the sulphite process of Benjamin C. Tilghman of Philadelphia was made commercially useful in Povidence, R. I., in 1884.

With invention after invention heaped at their disposal it was but natural that the enterprise of such editors as Bennett, Greeley, Bowles, Dana and Godkin led their papers to reach out to far-away places in efforts to meet a growing public interest in world news. The competitive spirit once aroused, the telegraph and cable bills soared, profits correspondingly diminishing. Publishers soon realized that by cooperating to divide the cost of gathering and distributing national and foreign news the expense to the individual paper would be lessened and the scope of the field covered could be greatly enlarged. Thus was conceived the modern American press association and news syndicate services, the latter being operated often by a large metropolitan daily and serving papers in other cities.

The American beginnings of organized news gathering took the form of more or less isolated groups of newspapers. Out of these through a long process of development of facilities and reorganization have come the modern press association of which the leading examples are the Associated Press and the United Press Associations, both world-wide in scope of operation. Their aim has been to gather from the ends of the earth the bare facts of the news and present it to their newspapers without comment or suggestion as to the conclusions to be drawn from the facts they chronicle. These press associations not only distribute news to American newspapers, but to the press of many foreign countries, and their dispatches are read by more than 150,000,000 people. To the genius of the late Melville E. Stone, its General Manager from 1892 until about ten years ago, the Associated Press owes much of the prestige of its present attainment. Today the two outstanding figures in the American press associations are Kent Cooper, general manager of the Associated Press, and Karl A. Bickel, President of the United Press. Other press services in this country are the International News Service, operated by the Hearst interests, and the Consolidated Press.

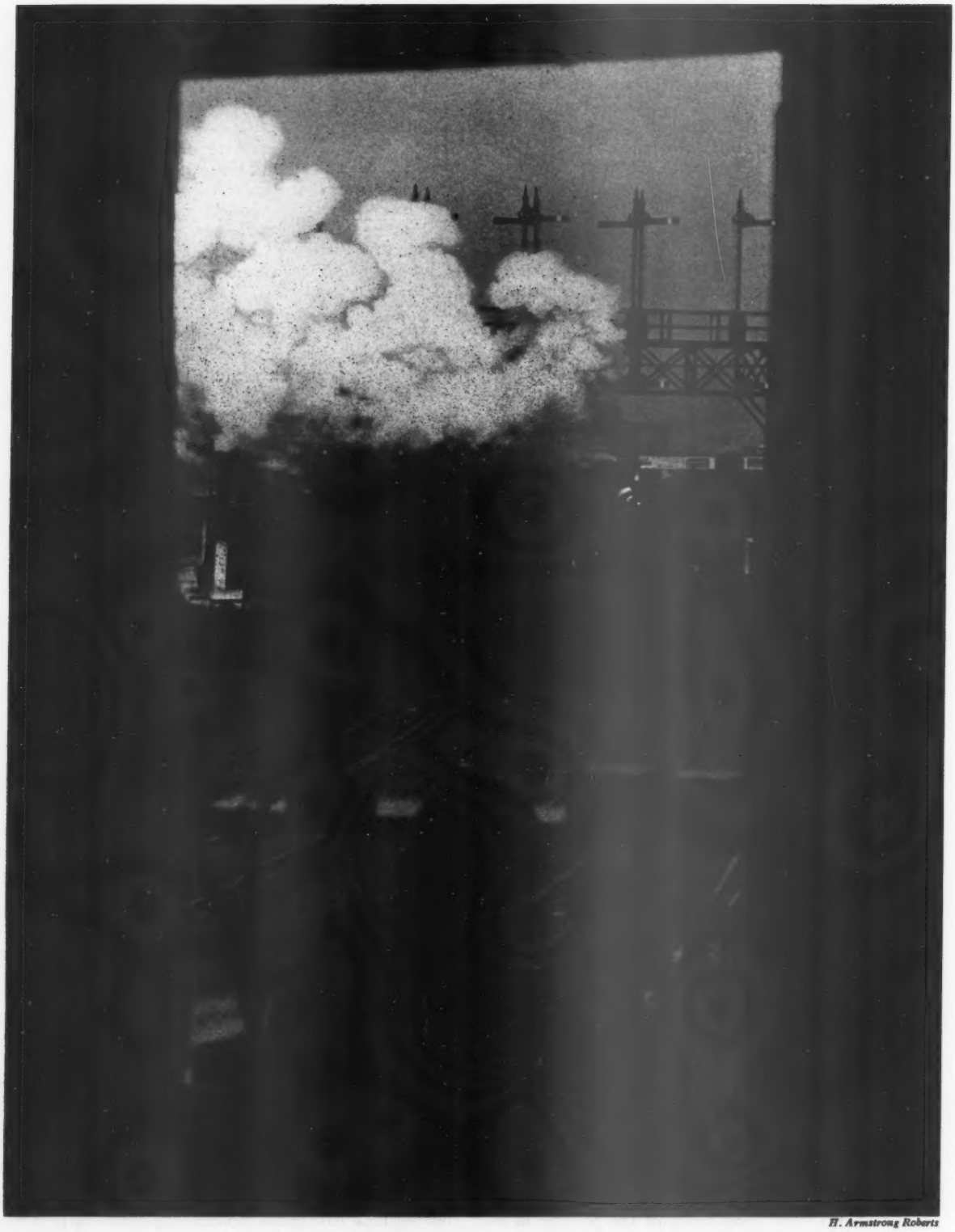
The great foreign agencies are *The Reuter Telegram Company, Ltd.*, of London; the *Agence Havas* of Paris; the *Continental Telegraphen Compagnie* or Wolff Bureau of Berlin, the Tass Agency of Russia and the Canadian Press. The first three antedated American press associations. Baron Julius von Reuter of Hesse Cassel in Germany first established himself at Aix la Chappelle in 1849. Aix was then the end of the telegraph from Paris and Reuter forwarded news from Aix to German papers by carrier pigeons. In 1851 he moved to London. Charles Havas established a carrier pigeon service from Paris to London and Brussels as early as 1835 and Dr. Wolff founded the German agency in 1849.

The sole responsibility of the modern press association is to gather the news of the world accurately and transmit it to member newspapers or clients as fast as possible. Freed from the responsibilities of the mechanical production of individual papers, these news-gathering organizations concentrate upon the collection and transmission problems. Gathering, writing and distribution of news by them goes on day and night without end. Every minute is a deadline and somewhere a newspaper is going to press.

Wireless telegraphy constituted the chief auxiliary adopted after the telegraph and telephone. It was first brought to commercial value by William Marconi of Bologna, Italy, who sent the first signals across the Atlantic in 1903. As early as 1907 some press dispatches were being transmitted, but newspapers and press associations were still skeptical of a channel of communication which at that time was somewhat unstable. Then one of the greatest stories of the century "broke" and wireless almost instantly became a major factor in gathering the news of the world.

At 12:36 P.M. on September 6, 1909, the Associated Press in New York received a message which had come by wireless and cable from Battle Harbor, Labrador. It said, "Stars and Stripes nailed to the Pole" and the signature was "Robert E. Peary." This was the first major newspaper story sent by radio and it could have come by no other means. Within ten minutes every newspaper served by the Associated Press received the news that Peary had accomplished the dramatic and dangerous task to which he had set himself. He had filed his dispatch at a little Marconi station at Battle Harbor whence it was relayed from point to point in the Marconi system until it reached Newfoundland. From there it was transmitted by cable to Canso, Nova Scotia, and onward by land wires to New York.

Contrasted with the facilities of today, Peary's great feat was a long time in reaching the newspapers for his announcement came six months after the day he reached the spot which his instruments told him was 90 degrees — the North Pole. Peary was out of communication with civilization for 400 days but Commander Richard Byrd and the late Floyd Bennett flew over the Pole in 1926 leaving their base in the morning and returning to it the evening of the same day. Newspapers told the story less than ten hours after the plane circled over the Pole. Six years after Peary's message, one of (*Continued on page 116*)



H. Armstrong Roberts

HIGH BALL!

AS THE TOWERMAN SENDS AND SEES AN EXPRESS ON ITS WAY

THE TREND OF AFFAIRS

Grandeur Movies

SWIFTLY OUTGROWING the black and white silence of its flickering infancy, the motion picture has within a morsel of time found its tongue and garbed itself in robes of many colors. And now, while Hollywood's best people are still frantically adding g's to "ing" words and trying to sip soup silently for the talkies, William Fox, far-seeing showman, motion picture opportunist, and first and last good business man, announces Grandeur pictures, which are photographed on a new wide film designed to cover a screen of full stage dimensions. Dazed by this bolt from the blue, Hollywood is again anxiously knocking at the door of the scientist and engineer for advice, (see the prophetic plea for engineers to enter the cinema industry by Joseph A. Ball, '15, in The Review last April) for the wide film announced by Fox is only one of a number which are being brought to perfection by leading companies.

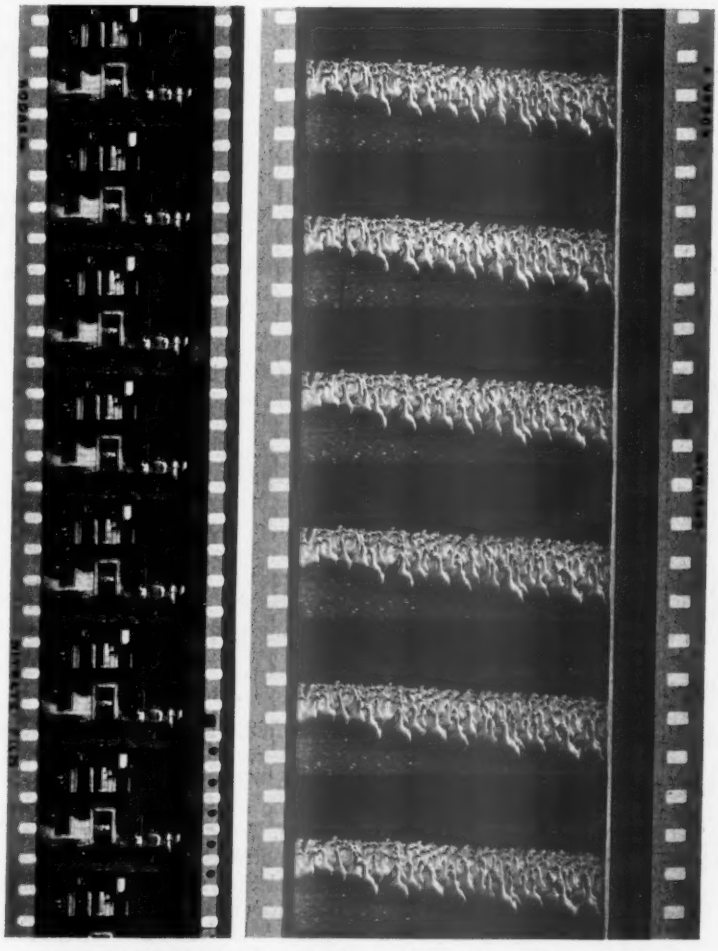
All this means new cameras and new projecting apparatus, huge screens and a new technique in the studio. While the veteran of the legitimate stage may smile complacently, the celluloid star must learn the art of make-up all over again. Scenery will have to be built with far greater attention to detail than is now the practice, and many of the camera tricks of the past must be discarded because of the new demands of an enlarged screen. When all these adjustments have been made the Broadway show girl, whole choruses of her in the full stature and colors of life, will be booked for the celluloid circuit to dance and sing on the screens of a thousand small town theaters from Ponkapoag to Tillamook.

The wide film will permit photography of far greater scope than is possible at present, a fact which offers the director and his man Friday, the art counselor, opportunities for mass effects hitherto unattainable. The new film will do away with the cramped sets now sometimes seen, but the closeup, it is predicted, can be used with an even greater palpitating effect.

The film used by the Fox-Case Company is seventy millimeters wide, exactly double the width of the standard film being used at present. The Paramount-Lasky Corporation is working on a film reported to be fifty-six millimeters wide, while the Radio Corporation of America is said to have decided upon a width between that of Fox and Paramount.

Aside from practical considerations, the question involves a nice little problem of proper proportion in the size of the projected image. It is already a matter of controversy. Cortland Smith of the Fox-Case Company says that seventy millimeters is the best width for their purpose. Furthermore, he calls attention to the fact that motion picture film is now manufactured in that width and then split into strips thirty-five millimeters wide for the present standard film. Thus, he holds, there need be no change in the film maker's machinery and production can continue without interruption if the seventy millimeter film is adopted.

That the wide film and the large screen will eventually come into general use seems assured. For the moment, however, the great need is



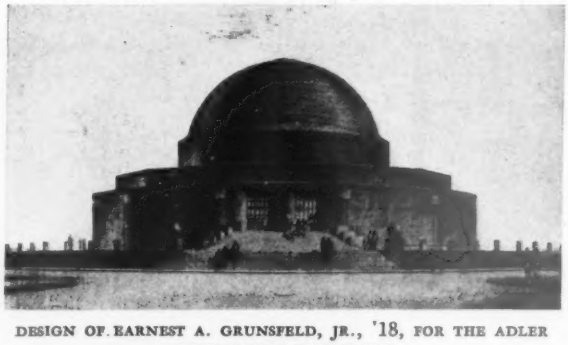
EXACT SIZES, FOR COMPARISON, OF REGULAR MOVIETONE AND NEW GRANDEUR FILMS

agreement upon a wide film of standard width for use in cameras and projectors of new design. The average exhibitor, still bowed under the financial burden of installing sound apparatus, faces the possibility of being forced to buy several machines to project films of special width. Aside from the expense of enlarging projection booths and installing the new wide screens, engineers estimate projectors of the new design will cost between $10,000 and $20,000.

Claims to the contrary notwithstanding, the wide film, while increasing the scope of motion photography, does not produce stereoscopic effect. The third dimension still remains the ultimate goal of the motion picture, an achievement which, with perfection of color and sound processes, would bring the screen an illusion difficult to distinguish from life itself.

Nicaraguan Interoceanic Canal

IN 1779 THE KING OF SPAIN sent an expedition to investigate the possibilities of building an interoceanic canal across Nicaragua. Nothing came of it. Seventy years later Cornelius Vanderbilt, then at the height of his power, decided he would dig the Nicaraguan ditch. But he changed his mind, built a road, and, linking the lakes and rivers of Nicaragua in a transportation system, complacently counted his profits. Now a battalion of the 3rd United States Engineers is on its way to Nicaragua to make a survey for a canal.



DESIGN OF EARNEST A. GRUNSFELD, JR., '18, FOR THE ADLER PLANETARIUM IN CHICAGO

The Spanish expedition, it seems, reported to a disappointed king that Lake Nicaragua, being some 134 feet above sea level, was in the way, making a canal out of the question. A persistent Englishman in that early field party argued to the contrary, but found no sympathetic ear.

Cornelius Vanderbilt, who learned navigation on his father's Staten Island ferry and later sent ships to the Seven Seas, organized the American Atlantic and Pacific Ship Canal Company in 1849 when the gold rush was at its height. The next year he abandoned his plans to build a canal and organized the Accessory Transit Company, which was to open a transportation system across Nicaragua, being served on the Atlantic and Pacific by his convenient and fast steamship lines. San Juan del Norte, later to be called Greytown, on the San Juan River, was chosen as one terminal, and, lacking an established community at the other end, the Commodore founded San Juan del Sur for his Pacific terminal.

Then in the face of advice and many real obstacles Vanderbilt brought ships to the Nicaraguan shore, and, driven by a will that knew no defeat, he managed with the aid of popping boilers, pike poles, warping lines and capstan heads to drag his vessels to strategic points on river and lake. Without convenient waterways on the last twelve miles to the Pacific, the Commodore built a fine macadam road, brought in stagecoaches painted blue and white, and put mule drivers in the seats to do the rest. Thus he smashed the monopoly of the Pacific Mail Company, shortened the journey to the Golden West by some 500 miles, and cut the fare $300.

The departure of Army engineers for the mosquito-infested Nicaraguan jungle came about through the activity of Ambassador Edge, who last March managed after much chitchat back and forth to persuade Congress to resolve itself in favor of a survey to determine the possibilities of a trans-Nicaraguan canal. And the Army, having had some experimental skirmishes with a certain gentleman of Central America, is sending its best to make the survey, not only because it has had experience, but because to do so saves money when economy in government is popular. Army transit and level men, chain luggers and rodmen will set out to prove that the Spanish king lost an opportunity and, perchance, that Commodore Vanderbilt was shrewd.

The climatic conditions facing the Army engineers today are the same that the builders of the Panama Canal were called upon to combat. They have the advantage, however, of the work of Gorgas. The malaria mosquito is no longer in complete control of his realm, for tropical medicine has made strides in recent years. Competent Army medical men will be there to carry on their own little war against jungle fevers. Quinine stocks will hold their own.

This formidable undertaking will be carried out under instructions to find a suitable route for such a canal, plus estimates of the cost of construction and maintenance, and to investigate land rights and franchises. A survey was made some thirty years ago by the U. S. Government, but with many advances in engineering methods, as well as costs of construction, it is now necessary to make an entirely new study of the country. It is estimated that the survey will require several years. After the report is made it will be the cue for someone to start an argument on building a canal.

Packets Redivivous

THEODORE ROOSEVELT, who was mainly responsible for the Panama Canal and gave consideration to one in Nicaragua, appointed the Inland Waterways Commission in 1907. In 1910, Congress passed the act under which dredging and damming for the vast hydraulic transport system began, the Mississippi being its "keel." Completion this autumn of the Ohio River project, a nine-foot channel from Pittsburgh to Cairo, Ill., opened a 2,000 mile waterway between Pittsburgh and the Gulf of Mexico on which motor barges can carry bulk freight between these points at less than half the cost of shipping by

THE MISSISSIPPI, "KEEL" OF HOOVER'S WATERWAY SYSTEM, AS IT DEBOUCHES INTO THE GULF

Wide World

rail. To look upon the Mississippi and its tributaries as arteries of commerce teeming with shipping, as in the days of the packets, is a cheering prospect. Lately it has figured more in the public eye as an agent of devastation. But flood prevention, or more accurately, flood control, is taken account of in the extension of this waterways program to which Mr. Hoover dedicated his address at Louisville.

Today the United States spends $50,000,000 per year on river and harbor development and $35,000,000 on flood control. Here are some things Mr. Hoover believes could be done by an additional $10,000,000 per year (for $20,000,000 more he could include the Great Lakes-St. Lawrence seaway project recommended by the Engineering Council. *Vide infra*):

The Mississippi could become a 9,000-mile water transport system reaching from the Twin Cities to the Gulf, with lateral waterways, provided through the development of the Illinois-Missouri, Arkansas and Tennessee Rivers, transforming them like the Ohio has been reconstructed. Five years would suffice for this. Meanwhile, improvement of the channels in the Great Lakes could be continued, their levels could be stabilized, and they could be connected by canal to the Illinois River and thence to the Mississippi. In ten years, the present 746 miles of intercoastal canals could be increased by 1,000 miles.

To this ambitious program, which it is estimated would cost per annum within $4,000,000 of the total expected cost of the Boulder Dam project, exclusive of the All-American canal, Mr. Hoover has pledged himself "with all the expedition which sound engineering will permit." He will surely need all possible support if "sound engineering" is to surmount considerations of practical politics. A vastly greater number of people will be affected by the program for the inland waterways than by Boulder Dam; consequently there will be a greater public demand for action. Already there has been a clamor against waiting for an adequate survey of the potentially flooded areas. Fortunately, however, aerial surveying methods have made it possible to accomplish this survey in three months. In all, 11,419 photographs were taken during 412 hours of flying and 8,481 square miles, an area greater than that of Massachusetts, was mapped.

Attempts to apply "sound engineering" to the waterways problem are not new. Seventy-odd years ago, the Government, through the Army Engineers, started the most intensive study of the hydraulics of great rivers that had ever been undertaken. Two young lieutenants published a bulky authoritative tome entitled, "The Physics and Hydraulics of the Mississippi River" and then, with the advent of the Civil War, this kind of work in America stopped.

As John R. Freeman, '76, said in The Review two years ago, though "the *art* has been somewhat further developed, the *science* of river hydraulics and river control has slumbered. It still slumbers in America . . ." but in Central Europe, especially in Germany, remarkable development of hydraulic laboratories has taken place. Mr. Freeman's achievements in hydraulic engineering on the Panama Canal, the Yellow River in China and on the

Goodyear-Zeppelin Corporation

DOCK AND HANGAR IN AKRON WHICH IS TO HOUSE THE "ZRS-4" AND "ZRS-5." IT IS 1,175 FEET LONG, 325 FEET WIDE AND 311 FEET HIGH. ITS FLOOR SPACE OF 364,000 SQUARE FEET IS THE LARGEST UNINTERRUPTED FLOOR IN ANY STRUCTURE

Keokuk Dam are well known. The Review will, therefore, be privileged to present next month his views of what has been accomplished abroad in the study of rivers and how hydraulic laboratories are essential to America if Mr. Hoover's "sound engineering" stipulation is to be fulfilled.

Public Lands

MR. HOOVER also has the idea that the Government might well turn over the surface rights of the remainder of the Public Domain to the States for them to administer. Originally, the public land totaled 1,455,000 acres, a no mean area, and, incidentally, equal to about half the present size of the United States. It was acquired largely by purchase and included the Louisiana Territory bought from France, and Florida from Spain, the Oregon country which came by treaty from England, and the Gadsden Purchase ceded by Mexico.

Up to the Civil War, the Government's chief source of revenue was through the sale of public land and, though the sale price averaged only twenty-five cents per acre, it had cost originally but five or six. Following the War, the need for immediate revenue became secondary to the need for the colonization of the West. Choice land, of course, went first, and later homesteading became a gamble. This gave rise to the saying that the homesteading meant the Government would bet a quarter-section against ten dollars that a man couldn't live on his 160 acres for five years without starving. But not all public land was distributed to settlers, for railroads, canals and wagon roads received grants totaling 137,000,000 acres, 35,000,000 acres became Indian reservations and 170,000,000 acres were set aside as National Parks and Forests.

Henry Clay, once remarked before the Senate, "long after we shall cease to be agitated by the tariff, the public lands will remain a subject of deep and enduring interest." That was in 1836 and, for a long time, Clay's prediction has seemed to be hopelessly in error. Though there are still left 200,000,000 acres in the Public Domain, most of it is west of the Mississippi (nearly a quarter is in Nevada), and it is largely barren wasteland.

Mr. Hoover's proposal and, especially his insertion of the word *surface* aroused curiosity and, in the minds of western politicians, renewed some of the excitement of the days when "land office business" was more than a figure of speech. What coal, oil or mineral rights may lie below the "grass root" rights? These are what Mr. Hoover would retain for the Government and, now that he has by indirection suggested these underground rights are worth thinking about, Henry Clay may receive temporary vindication by the attempts to induce Mr. Hoover to yield full rights to the States. If he refuses, the public lands question will probably remain dormant. But, if he does yield, the last of the Government's free land outside of the Territory of Alaska will be disposed of and Clay's prophecy, like many others, given a one-way ticket to limbo.

Engineering Council

LUSTILY APPROVING and disapproving these many public measures and projects, the American Engineering Council continues to make itself heard in Washington. Last month The Review recorded that watchful body's carefully considered protest against the Jadwin "fuseplug" flood control plan for the Mississippi. Since then it has *deplored*, as a certain liberal weekly would put it, the following:

1. The Crampton Bill (passed by the House, defeated by the Senate), designed to exclude everyone except licensed attorneys from practising before the Patent Office. Members of the Council's administrative board pointed out that the bill would prevent engineers from advising clients on technical aspects of patents, characterized the bill as a "law for lawyers," and proposed an amendment permitting engineers and scientists to render technical, nonlegal service in patent applications.

2. The King Bill to provide compulsory licenses for unused patents.

3. The Walsh Bill to require contractors engaged in public works to give certain preferences in the employment of labor.

4. The James-Schneider Bill to prevent the use of stop watches and time-studies in the postal service.

During the same period the Council has *applauded:*

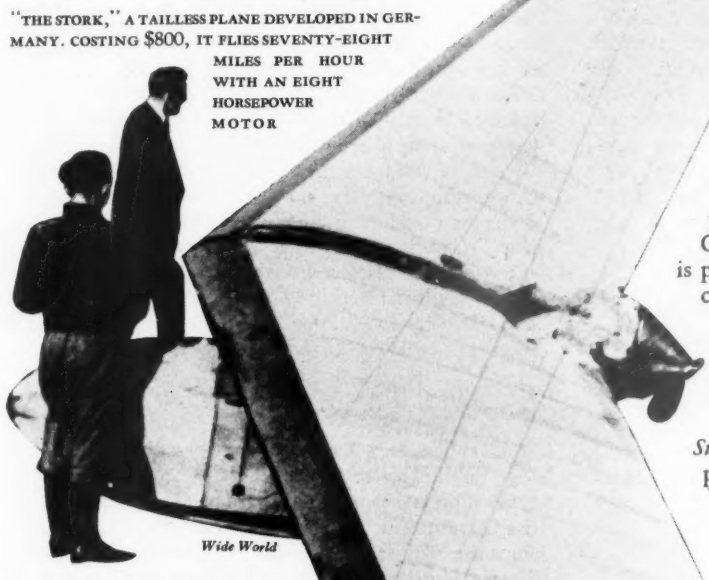
A. The proposal for the construction of the St. Lawrence seaway, permitting the passage of ocean going vessels from the Great Lakes to the Atlantic. It requested

Mr. Hoover to appoint civilian engineers, both American and Canadian, on the International Board of Engineers.

B. A bill authorizing the employment of civilian engineers for the Air Corps and Ordnance Department.

C. The reconstruction by the engineering profession of the Potomac Canal for the George Washington bicentennial celebration in 1932. This canal was built by Washington to take boats around Great Falls.

D. The Reed Bill authorizing the Secretary of War to lend aeronautic equipment and material to accredited schools, colleges, and universities throughout the United States for use in aeronautical instruction and research.



"THE STORK," A TAILLESS PLANE DEVELOPED IN GERMANY. COSTING $800, IT FLIES SEVENTY-EIGHT MILES PER HOUR WITH AN EIGHT HORSEPOWER MOTOR

Wide World

E. The McLeod Resolution for the creation of a commission to study the causes of and the remedies for business depressions and unemployment.

F. A resolution suggesting a national museum of engineering and industry.

G. Bills creating a safety division in the Bureau of Labor Statistics, and providing for the coördination of the Federal Government's public health activities.

Foreign Aviation

PASSING WEEKS in New York bring new and higher skyscrapers, in Germany new and larger airplanes. The *DO.-X* (Dornier) seaplane which recently took to the air powered by twelve motors and loaded with over one hundred passengers, received justified recognition the world over. Its precursor was the staunch Rohrbach *Romar*, most seaworthy of seaplanes.

Not content with building the largest flying boat, Germans next presented the Junkers *G-38*, the largest of land planes. This craft is appreciably smaller than the Dornier, carrying only four motors totaling 2400 horsepower. It is seventy-five feet long against the 131 feet of the Dornier, but it is wider — 180 feet against the *DO.-X's* 157. It contains structural novelties, however, profoundly important to future design. The crew, passengers, and most of the freight and fuel are carried in the wings. Between these enormous flying surfaces is room for thirty-four people to walk about comfortably through the sleeping cabins, dining room, smoker, and kitchen. The plane is capable of making 130 miles per hour.

The Dornier Works announce another flying boat similar to the *DO.-X* which has been ordered by Gar Wood, speed boat racer. Its design calls for four engines, each of 500 horsepower, a span of 102 feet, a length of eighty-two feet, and a passenger capacity of twenty-seven. Another German firm headed by Dr. Edmund Rumply is proposing a seaplane for transatlantic service capable of carrying 170 passengers and propelled by ten motors yielding a total of 10,000 horsepower.

Another German designer, Alexander Lippisch, working for a minimum rather than maximum size, has developed *The Stork*, a tailless plane, shaped like a caret and propelled pusher-fashion by an eight horsepower engine. Its flying qualities, according to newspaper reports, are astounding, its stability remarkable. Expert judgment on it, however, is not yet obtainable. And finally, to round out an autumn of European progress, comes news of an all-metal fighting plane, the Bristol *Bulldog*. Authority for this derives from the National Advisory Committee for Aeronautics. The *Bulldog* is capable of a speed of 172 miles per hour and a ceiling under full load of 31,200 feet. Its entire structural portion is of high tensile steel, designed on the Bristol principles of metal construction.

Monster Dirigible

WHILE GERMANS are finishing their huge land and sea planes, the Goodyear-Zeppelin Corporation in Akron hastens construction for the Navy of the *ZRS-4*, destined to be the largest lighter-than-air craft. Its gas capacity is to be almost twice that of the Graf Zeppelin, its master ring's diameter equivalent to the height of a twelve-story building, its length more than matching the length of the R. M. S. *Mauretania*.

The Goodyear-Zeppelin Company's President, Jerome C. Hunsaker, S.M.'12, related in The Review of last May the events leading up to this great step in airship design — the acquirement by his company of American rights to Zeppelin patents and the loan by the German firm of its chief engineer and allied key men. At the same time he described plans to place the eight engines of the *ZRS-4* in the craft's viscera instead of suspending them as have all other designers. The use of helium gas makes this possible as it does the construction of the airplane hangar for five planes which the ship is to carry.

A comparison of the *ZRS-4's* dimensions with other airships emphasizes its Pantagruelian size:

	Length	*Height*	*Gas Capacity*
Los Angeles	658	104	2,470,000
Graf Zeppelin	776	98	3,700,000
R-101 (British)	709	133	5,000,000
ZRS-4	785	146	6,500,000

The immense hangar and dock, likewise an engineering triumph, in which the ship is being constructed, is pictured and described on page 90.

Airplane Safety

MERE SIZE in airplane design, however, is not the most important thing. The problem of safety demands more study and is harder of solution. A number of American organizations are concentrating on this one factor. The Guggenheim Fund for some time has been financing the study of fog flying and flying blind by instruments and the work done for it by Professor William G. Brown, '16, and Lt. James H. Doolittle, S.M.'24, is bearing fruit. The Fund at the present time is also sponsoring a safe aircraft competition for which prizes totaling $100,000 are offered to plane designers and builders who submit machines with new and valuable safety features.

The Army Air Corps is likewise conducting experimental work and it recently conducted a successful test with the Sperry Gyroscopic Stabilizer which is designed to keep planes straight on their course in level flight. The successful use of this device would do much to reduce the constant strain imposed upon pilots who are forced to watch a fatiguingly large number of instruments.

The necessity of making pilots more efficient and of relieving them from excessive strain is shown in the results obtained in an investigation sponsored by the Assistant Secretary of the Navy for Aeronautics. It was found that fifty-two per cent of all accidents are caused by errors of pilots, eighteen per cent by power plant failures, thirteen per cent by structural failures, nine per cent by poor airport conditions, two per cent by inclement weather conditions, two per cent by supervising personnel, and four per cent by miscellaneous causes.

Engineering Congress

ON PAGE 79 The Review is publishing an important article derived from a paper delivered by Professor Dugald C. Jackson before the World Engineering Congress which met during the first week of November in Tokio. During the year The Review will publish other important material presented by notable American engineers before the Congress. Professor Jackson, who is Chairman of the American Program Committee, has made it possible to obtain these papers, and to him The Review and its readers are much indebted.

The manner in which the Congress was conducted redounded greatly to the credit of Japanese engineers. The delegates from all countries were enthusiastic about the warmth of the Japanese hospitality and the evidences of engineering enterprise and progress. About 800 papers were presented before the Congress, the largest percentage of which were written by Americans. The various phases of engineering discussed in these papers and those at the small sectional meeting of the World Power Conference, held simultaneously, make an important and valuable contribution to the advancement of engineering.

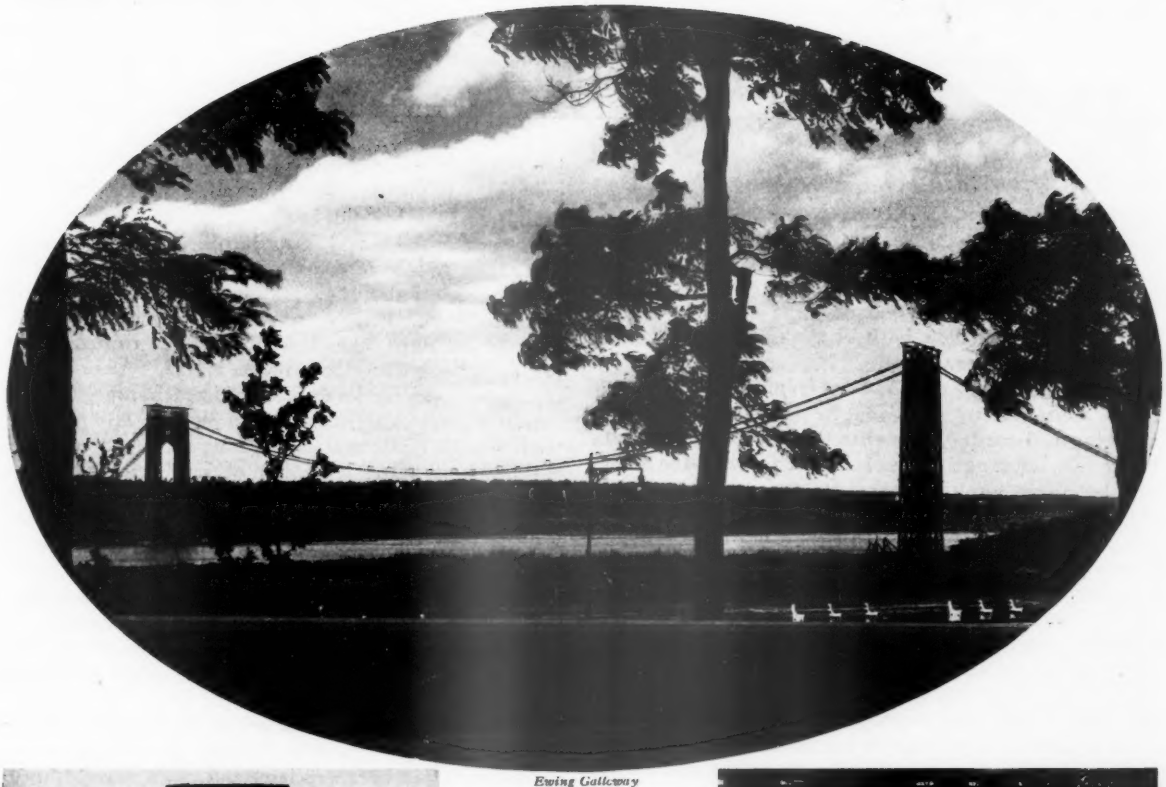
Vanishing Scourge

ALTHOUGH a recent estimate of the United States Public Health Service indicates that but 306 of the 1,200 supposed lepers in this country are being treated in the Government leprosarium at Carville, La., the decade since the War has seen vast strides in the conquest of this disease. Until comparatively few years ago the aphorism, "Once a leper, always a leper," was sufficient to destroy all hope in the afflicted and to bring consternation to family, friends, and community.

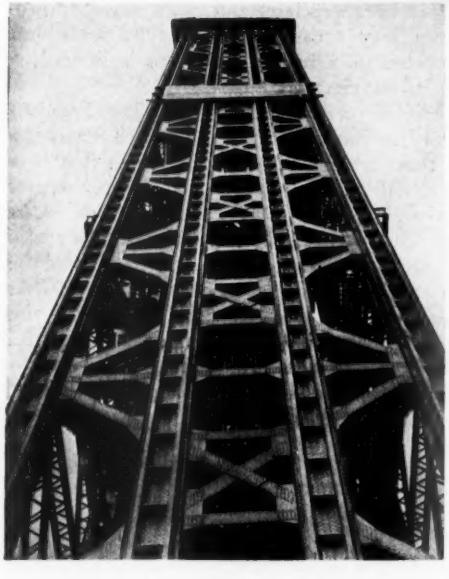
This great scourge of mediaeval Christendom was endemic from earliest times in the delta and valley of the Nile, yet barely fifty years ago came the discovery of its causative agent, *b. leprae*, by the Norwegian scientist, G. Armauer Hansen. His work cleared the way for the removal, from the sufficiently evil name of leprosy, of a number of similar but essentially different diseases; and the diagnosis of leprosy today is rarely made, even by an experienced physician until the leprosy bacillus has been found in the suspect.

Since 1910 there has been a new and more hopeful outlook on the treatment of this ancient affliction, at least in its earlier stages. Constructive effort in the United States did not crystallize until February, 1917, when Congress enacted legislation and provided funds to set up the leprosarium in Louisiana. But in other parts of the world the problem was more acute and the fact that the great majority of the two to three millions of the world's lepers were in tropical and subtropical Asia and Africa where the disease thrives in the hot, damp climate, led to much fruitful study and research.

Numerous suggested remedies, having failed to fulfill their early promise, only the Indian drug, chaulmoogra oil, was known to have some power of retarding the



Ewing Galloway



PROGRESS ON THE HUDSON RIVER BRIDGE, THE WORLD'S LONGEST SINGLE SPAN. ITS TOTAL SPAN IS 3500 FEET, THE HEIGHT OF ITS TOWERS 650 FEET

progress of the disease. Taken orally its use was difficult because of its nauseating properties, but slightly better results were obtained by Victor G. Heiser in the Philippines by intramuscular injections. This, however, was painful and few patients could submit to it, even if willing. In 1916–1917, L. Rogers injected the soluble salts of the fatty acids of chaulmoogra and other oils. Later Dean and Hollman at Honolulu introduced the practically important modification of using intramuscular injections of ethyl esters in the place of the more troublesome intravenous ones of the sodium salts.

The results of the last four recorded years in Hawaii have been that the cases discharged numbered fifty-three per cent of the 399 admissions. The number of lepers is being reduced at a rate which will nearly solve Hawaii's problem within about twenty-five years. In India a new substance, sodium hydrocarpate, has been tried and found easy to administer, cheap, and very effective.

BOOKS

Imperialistic Machines

THE IMPERIAL DOLLAR, by Hiram Motherwell. $3.50. 310 pages. New York: *Brentano's*.

THE effect of the advance of technology upon world politics and world economics, and especially upon America's share in them both, is the theme of this new book of Mr. Motherwell's.

"The common jibe that America is 'machine made,' he says, "is historically true." But he admits the fact with equanimity, since he holds that the imperialism which has resulted from this reign of the machine is in the main of a beneficent sort that makes for the general good of the world as a whole. America's imperialism is of a new type. It is the work not of politicians but of engineers, however unconscious the engineers themselves may be of that fact.

"In short, the American Empire which built its foundations in three decades following the Spanish-American War was not the work of imperialists. It was the work of the machine, grinding out wealth in a frenzy of newly discovered vigor. One might almost say it was a blind force of nature. It was not the politician who guided the process. At almost every single step the politician looked on puzzled and half-helpless, often resorting to some panic-stricken half measure which only placed an obstacle in the path of the empire. For the American people did not know what was taking place."

One naturally asks why the machine has not affected European empire-building in a similar way. Mr. Motherwell's answer is to point out the amazingly happy coincidence between the European industrial revolution and the American political revolution. "All unconsciously Washington was collaborating with Hargreaves and Arkwright and Watt. While they were creating the modern machine, he was creating the terrain on which it would eventually be free to function to the utmost capacity. The two revolutions were destined to merge into one great process, the process today known as Americanism." In Europe, the machine revolution could not go so far because innumerable tariff barriers reduced markets and interfered with the free flow of raw materials.

Unhampered in America, the machine first satiated the American market and then began to force its overplus on the world market, supported by a low production cost which the rest of the world could not match.

A series of memorable dates mark the stages of the process. By 1875, the United States was exporting more than it imported. By 1896, there were large sums left over for foreign investments, and the United States was on the way to becoming more industrial than agricultural. Gradually, the idea grew up that not only must American investments in the Caribbean and adjoining countries be encouraged, but that pretexts for European interference must be ended. Hence "the policy of protecting and forcing dollar investments not so much for their own sakes as for the sake of squeezing out European investments, new and old."

Then came the World War. Europe, frantic for American goods, re-sold to Americans hundreds of millions in American securities. America diminished its own debts and increased credits. "At some time in the year 1916, the two elements met, and then crossed. The United States became a net creditor toward the world." America was committed once for all to creditor imperialism.

And a good thing, too — according to Mr. Motherwell. For he holds that in the long run imperialism of this sort necessitates promotion of the general good; and that America will have to seek to increase foreign markets by increasing foreign purchasing power, precisely as we have increased domestic markets by increasing domestic purchasing power. "Those who would explain modern imperialism must take into consideration this fact: that it cannot long prosper by taking things from others; it must eventually seek to sell things to others. It must in its own selfish interest seek to provide others with purchasing power."

Hence the benefits of American imperialism to the world at large — benefits which the world seems singularly slow to appreciate. But, says Mr. Motherwell, "Nations may occasionally profit by wars, but empires can profit only by peace." Here is, indeed, a supreme benefit. But can we confer it?

Mr. Motherwell will not convince any Spanish-Americans that the imperialism of the United States is a good thing, though some of them may agree that it is inevitable. He will not convince many Europeans, nor will he convince all Americans. But this is not necessarily adverse criticism of his book. Whether it persuades the reader or not, it makes a good case for one view of the matter. It will teach every reader a good many things that he needs to know, and its urbanity, intelligence, and sincerity will make the process agreeable. A very useful and important book, which ought to be read by every American who concerns himself with foreign policy — especially the professional baiters of their own government.

JOHN BAKELESS

Travel Amenities

LOAFING THROUGH AFRICA, by Seth K. Humphrey, '98. $5.00. 376 pages. Philadelphia: *The Penn Publishing Company*.

MR. HUMPHREY is a globe-loafer of experience, prudence, and foresight. Besides, he can talk entertainingly about what he has seen. If you have ever met him, or have heard him lecture, it is sufficient to know additionally that in his books the sprightly anecdotes and sage conclusions lose nothing by transference to the printed page.

"Loafing Through the Pacific," his previous travel book, received notice in these columns back in November, 1927. It has now been reissued uniform in format with this newer volume on Africa. This is well, for the African one is much more adequately dressed than the first edition of the Pacific book, its photographs are reproduced better (including the one opposite page 238, which Mr. Humphrey said he took for "her beautiful eyes," though they do not show in the picture), and it has nice, helpful endpaper maps as do most good travel books. Possibly the latter improvement may have been due to a gentle hope expressed by this reviewer two years ago.

The entry into Africa was at Cape Town from which point he struck out north toward the Equator, stopping at Kimberley in the diamond country, Johannesburg to check the gold supply, and historic Pretoria and Mafeking. At Victoria Falls on the Zambesi River, beyond which nobody goes unless they have business — "except once in a while a man who has no business to be going beyond —," he paused three weeks for connections up into the Belgian Congo, to Elizabethville, Kabalo, and Lake Tanganyika. This, the longest fresh water lake in the world, he crossed, then proceeded to Tabora, which the Germans laid out to be a town of 50,000 and which had when he was there a population of 134 white people.

From Tabora northward he journeyed by a succession of motor trucks to Victoria Nyanza. Three days eastward across that lake brought him to Kisum, after a day at Jinja, where the lake waters spill over Ripon Falls and become the White Nile. Hippos play in Lake Victoria, and black schools of fish sport in the Nile within a half-mile of each other. Southeastward he continued, now by rail, through Nairobi, capitol of Kenya's big game paradise, to take ship at Mombasa and go down the east coast, putting into various ports like Beira in Portuguese East Africa, Durban in Natal. At Durban he transhipped to a freight boat, continued on southward, rounding the Cape of Good Hope and changing direction to the northward to Walfish Bay. Then he left Africa, consigning himself to a thirty-one day voyage on a freighter back to America via Trinidad.

"Browsing among peoples" is the way Mr. Humphrey derives his chief satisfaction in rambling about. To probe their inward feelings, he assumes the attitude of a temperamental dissembler and his premeditated and seemingly ignorant and ingenuous quizzings have provoked honest retorts from Manila to Zanzibar, including way stations as unlike as Los Angeles and Mwanza.

Most of his loafings, at least those of which he has submitted an account for public consumption, have been in the tropics. There, he succinctly says, nobody hurries and "there are delightful intervals of nothing to do." But, he continues, not everything in the tropics is delightful, and the "usual conception of the tropics as a place revelling in fruit and vegetables is all wrong. . . . Almost everything on a well-furnished table anywhere near the Equator has to be shipped in from the temperate zones. . . . The tropics generally are the home of the tough chicken and the tin can." Then, too, in Africa the tropics are the stamping-grounds of flies such as tsetses, anophele mosquitos, and spirillum ticks — the latter being the carriers of relapsing fever, one of Africa's worst — with quinine as one of the necessaries of life.

In his travels, as he reports them, there is lacking any indication that Mr. Humphrey ever loses his temper even though his baggage may go astray at a place like Albertville, Lake Tanganyika's west-side port, — darkest Africa where is the first hotel in "900 slow-moving miles." He says, "It doesn't do to get excited in the heat of Equatorial Africa. Otherwise I might have got excited. As it was, my calm but earnest demeanor as I tore along the lake front, losing weight from every pore, gained for me sympathetic and advising friends." Just as the steamer's whistle blew there came "two mature blacks with my bags aloft, hastening for the boat. . . . Then I took a bath, and smoked out the incident for good. In the tropics — and elsewhere, for that matter, only in a less degree — one who harbors annoyances gone past trifles dangerously with his health."

This philosophy apparently accounts for his reported imperturbability under equally trying circumstances. If a rikisha driver takes him by mistake to an opium factory, or worse, at Macao, he blandly says drive on, if Pango-Pango's "Astoria" is a false alarm, he chuckles and only wishes the lone sheet were longer so he would not have to see the mattress; if the Belgians, crafty fellows, give him a one-day pass to see the mines and smelting works of the *Union Minière du Haut Katanga*, and that day happens to be King Albert's birthday on which everything closes down, it is their loss and not his; if a truck driver expects his truck to go through anything a young gazelle could jump over, and consequently jams his gears so hard he strips the differential, and if this happens in an African swamp seventy-five miles from the nearest garage — Mr. Humphrey accepts the situation as but another chance to gather more data out of one more exasperation.

Since this African book, which has been in preparation two years, has now emerged with credit to author and publisher, it is to be hoped that the former projects further foreign loafings. He owes it to the armchair globe-trotters he has created and this reviewer recommends South America next, or India, or, better still, Soviet Russia. Somehow, the idea of Seth Humphrey browsing among the Volga boatmen, safely armed, of course, with a letter of credit from Senator Borah, has infinite literary possibilities.

H. E. L.

Snobless

THE FINE ART OF READING, by Robert E. Rogers. $2.50. 299 pages. Boston: *The Stratford Company*.

NO man who completes his day's reading with the daily paper, no student who is satisfied with doing only the required reading, no adult who buries himself in the avalanche of modern novels, will know or care about this book. But for the reader who wants to read more, and wants to know what to read and how to read it, this will be a boon. For Professor Rogers has a mental bookshelf worthy of any man's envy and from it he draws, in the most engaging manner, pages or phrases to give point to his subject. The same ease and charm of his conversation which make his lectures, chiefly delivered impromptu, so widely attended and enjoyed are retained in the pages of "The Fine Art of Reading." Here is far greater claim for publicity than Professor Rogers's

address to the Senior Class of Technology in June, 1929, which has been the source of so many tirades and editorials.

In short, pungent chapters he tells the reader what to look for as he reads, taking in turn the varied standpoints of the teacher, the reader, the critic, and the writer. But so skillfully has he done it that he has avoided all that is pedantic and ponderous, all air of the text book. Not even errors in quotations wrongly attributed or misspellings of book titles can deviate the stream of his easy-flowing prose.

C. C. C.

Tough Hombres

VIGILANTES, by Hoffman Birney. $3.50. 346 pages. Philadelphia: *The Penn Publishing Company.*

THE TRUTH ABOUT GERONIMO, by Britton Davis, edited by Milo M. Quaife. $4.00. xvii+253 pages. New Haven: *The Yale University Press.*

FALL and winter publishers' lists indicate a bull market for tales of the Old West, literature of a period abounding with incidents of blood-letting and elemental justice, inevitable accompaniments of the westward moving course of empire. Its characters are dubious fellows, road agents, rustlers, gamblers, and murderers; intermingled with the usually more desirable pioneers, miners, stage drivers, trappers, soldiers, cattlemen, sheriffs, and Indians. The Indians really require separate mention; they were apt to be good when on the reservation, but when they left it they were pretty sure to be bad.

Mr. Birney's book puts together the story of the rise and fall of Henry Plummer and his gang of outlaws in and about Virginia City, Mont., in the early Sixties. Plummer, unquestionably a most exceptional individual and one of the most distinctive personalities that can be found among the bad-men of Montana, was sheriff of the Bannack district and was at the same time, a road agent. He, and most of his men, were hanged through the activities of the members of the law-enforcement association — the Vigilantes of Montana — who banded together December 23, 1863, with the words, "Men, do your duty!"

Lt. Davis was with L Troop, 3rd U. S. Cavalry, during the campaign of 1885–1886 against the Apaches under Chief Geronimo and, with the help of Mr. Quaife, he has set down his recollections. "In this campaign thirty-five men and eight half-grown or older boys, encumbered with the care and sustenance of 101 women and children, with no base of supplies and no means of waging war or of obtaining food or transportation other than what they could take from their enemies, maintained themselves for eighteen months, in a country 200 by 400 miles in extent, against 5,000 troops, regulars and irregulars, 500 Indian auxiliaries of these troops and an unknown number of civilian auxiliaries." Finally Geronimo was forced to surrender, he and his followers being transported to Florida, there to be confined in army forts at Pensacola and St. Augustine.

The present volumes are but two meritorious examples of current contributions to the bibliography of the Old West. "Famous Sheriffs and Western Outlaws," by William M. Raine (Doubleday, Doran) or "The Day of the Cattlemen," by Ernest Staples Osgood (University of Minnesota Press) might have been selected. Or, two other books from the Yale University Press would have served: Captain James B. Gillett's "Six Years With the Texas Rangers" and Mr. Quaife's own "Yellowstone Kelly," the memoirs of General Miles's chief of scouts during the various campaigns against the Indians in 1876.

Conditions may still be primitive in isolated sections, sparsely settled because of climatic conditions, but law and order today appear firmly rooted on the old frontier. One is more likely to run into a bandit in the bootlegger's urban hunting grounds at the south end of Lake Michigan. The point is, after all, the Old West has passed; therefore it is commendable that its story is being plentifully recorded on paper while eye-witnesses are yet alive, for its contemporary records are meager or non-existent.

H. E. L.

Brief Reviews

THE AMAZING BENJAMIN FRANKLIN, compiled and edited by J. Henry Smythe, Jr. $3.00. xix+296 pages. New York: *F. A. Stokes Company.*

THIS farrago of forty-five tributes to Franklin, all from different sources and treating of different facets of the man, seems hardly worth the candle. Few of the contributors (among them Hoover, Hughes, Henry S. Pritchett, Alexander Millerand, Andrew Mellon) present any new material. The Philadelphia chapter of the Sons of the American Revolution, the organization sponsoring the book, could have rendered a much greater service to Franklin's name had it spent its money in promoting historical research into Franklin's life and times. His memory does not need lip service that merely gilds refined gold.

THIS AVIATION BUSINESS, by Ernest W. Dichman. $3.50. xiv+274 pages. New York: *Brentano's.*

NEITHER impressive nor sympathetic are the first four chapters which could have been made a fascinating though abbreviated history of aviation. A newspaper necrology could scarcely lack more of the human element; names, flights, and failures are so prosaically recorded. It is easy enough for us, looking back over the short period that spans aviation, to recognize blunders and misconceptions of the pioneers, but it is harder for us to understand and appreciate their courage and persistence in mastering the air. Refreshing, however, is the limitation of the account of Lindbergh's Paris flight to one paragraph, keeping him thus in proper proportion to the achievements of other fliers.

But the author aims, not to write a history, but to use history to clarify his explanation of present flying conditions which are still far from satisfactory, and to forecast a future of flying that will be more nearly perfect. This he does in a sane and practical fashion that is worthy of praise. Safety is an element that Mr. Dichman cannot overstress, and his illuminating chapter on "Aviation as a Career" should be read by every boy with aeronautical ambitions. We need more books that can be honest in this fashion.

THE INSTITUTE GAZETTE

Tax Settlement

REALIZING that the benefit of having educational institutions in the city limits of Cambridge might be overbalanced by those educational institutions withdrawing more and more property from the tax list, the Institute, Harvard, and Radcliffe College have entered into an agreement with the city to pay taxes upon certain of their holdings. Only a part of the Institute's property is affected, five acres approximately of the thirty west of Massachusetts Avenue are to be taxed under the agreement. The Institute will pay, in round numbers, $6,000 per year tax.

When one realizes that Cambridge, with an area of six and one-half square miles, finds herself with one and one-half square miles of her land occupied by schools, the anxiety of the city fathers can readily be understood. Constantly expanding, as the institutions are, the point might some day be reached when they own so much property as to make the tax rate in the remainder of Cambridge prohibitive.

C. E. MEES, VICE-PRESIDENT OF THE EASTMAN KODAK COMPANY, WHO SPEAKS TO THE NEW YORK TECHNOLOGY CLUB ON DECEMBER 2

Faculty Changes

SINCE the November number of The Review went to press, thirteen changes in the Faculty have been announced. C. Fayette Taylor, Professor of Aeronautical Engineering, who came to Technology in 1926, has been appointed Acting Head of the course in Aeronautical Engineering to take the place of Professor Edward P. Warner, who resigned last June to become Editor of *Aviation*. Lt. Col. Robert C. Eddy, since 1927 Executive Officer of the Department of Military Science and Tactics, becomes Head of that Department vice Colonel Harold E. Cloke, who has been transferred to Honolulu.

Shatswell Ober, '16, since 1922 Research Associate in Aeronautics, has been appointed an Associate Professor of Aeronautical Engineering and Thomas R. Camp, S.M. '25, who has been chief designing engineer with Alexander Potter in New York, joins the Faculty as Associate Professor of Sanitary Engineering.

There are three new appointments to Assistant Professorships of Military Science and Tactics: Majors Robert Arthur, Peter H. Ottosen, and Lt. Clarence L. Adcock. Major Arthur, who has been Librarian of the Coast Artillery School at Fortress Monroe, becomes Executive Officer of the Department; Major Ottosen and Lt. Adcock assume charge of the Coast Artillery and Engineer units respectively. Previously, from 1920 to 1924, Major Ottosen served on detail at the Institute in the Department of Military Science and Tactics.

Major F. S. Winslow and Lt. A. T. W. Moore, of the Department of Military Science and Tactics, and Lt. R. D. Thomas, U.S.N., have resigned, as did Colonel Cloke, because of service transfer.

Alexander S. Jenney, '83, has been forced to resign from the Faculty because of poor health. Professor Jenney, who first joined the staff in 1914, giving the courses in Office Practice in the Department of Architecture, became an Assistant Professor of Architecture in 1927. During the past year his health had been failing but it was expected he would recover sufficiently to resume active teaching, but, unfortunately, his continued sickness made his resignation imperative. Dr. Per K. Frolich, '23, who last June was appointed Associate Professor and Assistant Director of the Research Laboratory of Applied Chemistry, has resigned to enter the employ of the Standard Oil Company of New Jersey.

Lectures

YEARLY THE INSTITUTE supplements its own instruction with lectures given by notable and learned visitors. It likewise contributes to the public weal by presenting lectures given by members of its own staff to the outside public. Of the former type, the Institute has many, but its best known series is that established by John E. Alfred and designed to acquaint seniors with successful men and methods from the field of practice. Two lectures in this series have already been announced: on December 6, Ralph Adams Cram, distinguished architect and mediævalist, speaks on "Building a Great Cathedral"; and on January 17, C.-E. A. Winslow, '98, Anna M. R. Lauder Professor of Public Health in the Yale School of Medicine, speaks on "Health Conservation, A Problem in Citizenship."

The Society of Arts series given by members of the Institute staff for the public include: Frederick K. Morris, Associate Professor of Structural Geology and former geologist of the Roy Chapman Andrews Asiatic Expedition, speaking on "A Geologist's Travels in the Gobi Desert" (December 15); John W. M. Bunker, Professor of

Physics and Biochemistry, speaking on "From Molecule to Man" (January 12); Robert S. Williams, '02, Professor of Physical Metallurgy, lecturing on "The Romance of Metals" (February 9); and Maurice deKay Thompson, '98, Associate Professor of Applied Electrochemistry, discussing "Electricity and Its Chemical Effects" (March 9).

New York Club Dinner

SPEECHLESS DINNERS, while not originated by The Technology Club of New York, have been wisely chosen by it as a part of its program to draw Technology men together and to contribute to their gaiety. In the place of speeches they have substituted "demonstrations." Last year Sergius P. Grace, Assistant Vice-President of the Bell Telephone Laboratories, presented a demonstration lecture on sound and its transmission.

This event was so successful and well received that the Club this year again holds an annual dinner concurrently with the arrival of this Review in the mails on December 2. The scene is the Hotel Roosevelt, the old Waldorf-Astoria having succumbed to the building wrecker. The demonstration this year is to be presented by C. E. Mees, Vice-President and Director of Research of the Eastman Kodak Company, and his subject will be "The Formation of the Photographic Image." To illustrate his lecture he will use the new Eastman Kodacolor movies.

The Club is insistent upon informality and it emphasizes that the amenities of life and a chance to renew friendships will constitute the most important business of the evening.

Bulletin Number 23

NOT even the initial teeterings of the stock market kept off late October front pages headlines about the long-awaited report on "American College Athletics," which the Carnegie Foundation for the Advancement of Teaching now has available for free distribution. Since 1926 Dr. Howard J. Savage (who will be remembered as the author of "Bulletin Number 18" on games and sports in British schools) and his associates have been engaged on the field studies and the compilation of data for this "Bulletin Number 23." As was to be expected the press found "Number 23" better copy for, in its more unsavory details, the present report gets down close to brass tacks on the subsidation and recruiting of athletic timber by the colleges.

But, important and intriguing though the manifold ways to garner and support champions to make winning teams may be — and prevalent though such activity may be throughout the land — Dr. Savage's 400 pages present the complete story of American and Canadian intercollegiate athletics. He gives the historical background, the development of the modern amateur status, the varying means for the administrative control of athletics, the miscellaneous existing relationships of faculties, students, alumni, and coaches to the system. The hygiene of athletic training, the press and its emphasis on athletics, the results of athletic participation, and its values are discussed. On the future, "Bulletin Number 23" is an optimistic document. To be available next month there is a supplementary volume entitled "The Literature of American School and College Athletics."

One paragraph by Dr. Savage needs quoting in these columns: "The notion that intercollegiate competition is impossible, or at least impracticable, without subsidies is disproved by the fact that at twenty-eight of the 112 colleges and universities visited for the enquiry no evidence was found that athletes were subsidized by any group or individual." Technology's name appears as one of the twenty-eight.

After such a compliment it is ungracious to point out that Dr. Savage is in one place at fault — or that he is premature, perhaps. However, the report says (page 93) of swimming pools: "Among the most inviting may be mentioned those of . . . Massachusetts Institute of Technology. . . ." Can this be by indirection a tribute to the pool of the Boston Y. M. C. A. where the Institute swimming team used to practice, or to the allurements of the newer pool of the University Club of Boston which the team now uses?

141st Council Meeting

THE business session of the Alumni Council held on the evening of October 28 following the usual dinner in Walker Memorial came in like a lamb and went out like a lion. This change from halcyon to stormy weather was precipitated by a discussion of the by-law changes embodying the new plan for Corporation Term Membership selection as presented by a sub-committee of the Council last spring. Before Samuel C. Prescott, '94, the presiding officer, vice Harold B. Richmond, '14, at that time ill, opened the discussion on term membership selection, the Council had heard from two visitors, Francis J. Chesterman, '05, of Pittsburgh, a Vice-President of the Association, and Stuart R. Miller, '07, of Cincinnati. Both of these speakers took as their text the need for closer relations between the Institute and its outposts.

In comparison, the time between these two talks and the opening of the term membership discussion was a doldrum-like interlude. Reports were heard covering the activity of the Executive Committee, of the Secretary, and of the Treasurer of the Association. All of these reports, in substance pictured the Association in a prosperous and solid condition. During the interlude Dr. Prescott reminded the Council of the deaths during the summer of Henry F. Bryant, '87, Walter B. Snow, '82, Edward W. Rollins, '71, and Wallace C. Brackett, '95. The Council voted that a committee be appointed to prepare resolutions on the deaths of these men.

It is not possible here to give even a gist of the debate upon Term Membership by-law changes which followed. The upshot of the entire discussion fortunately makes this unnecessary, since it was voted that a committee be appointed to prepare a statement of the arguments in favor of and against the adoption of the proposed changes in the by-laws and to submit them to the members of the Association for a vote; and additionally, that a second ballot be submitted to those of the clubs who may be persuaded to vote upon the question corporately as clubs. The Council further voted that a committee be appointed to study methods for maintaining closer contacts between the Association and the Technology clubs.

ADVERSARIA

Rescued

BY cowboys, Lt. Albert F. Hegenberger, '17, co-pilot with Lt. Lester J. Maitland in the first crossing of the Pacific to Hawaii by air; from being attacked by a bull when forced down near Clovis, New Mexico.

Honors

¶ To Bradley Stoughton, '96, Professor of Metallurgy and Head of the Department of Metallurgy at Lehigh University; the Grasselli Medal for 1929 for his notable paper, recently prepared, on "Light Structural Alloys."

¶ To George F. Swain, '77, Professor of Civil Engineering at Harvard University, the Benjamin G. Lamme Medal of the Society for the Promotion of Engineering Education. Dr. Swain is the first to receive this new Medal which, henceforth, will be awarded annually in accordance with the will of the late Mr. Lamme. The bestowal to Dr. Swain was for his contribution to the advancement of the art of technical training.

Appointed

¶ Lewis H. Kunhardt, '89, to be President of the Boston Manufacturers Mutual Fire Insurance Company. He succeeds Joseph P. Gray, '77.

¶ Frederic H. Fay, '93, Chairman of the City Planning Board of Boston and Chairman of the Board of Zoning Adjustment of Boston; to succeed Henry I. Harriman as a member of the Metropolitan Planning Board of Boston.

¶ Horatio M. Parker, '94, to be Vice-President of the International Association of Dairy and Milk Inspectors.

¶ Charles B. Page, '99, to be President of the Steam and Combustion Company of Chicago.

¶ Katharine Blunt, '03, of the faculty of the University of Chicago; to the Presidency of Connecticut College for Women.

¶ Richard D. Gatewood, '05, for the last nine years in charge of the United States Shipping Board Bureau of Maintenance and Repair; to be General Manager of the United States Salvage Association in New York.

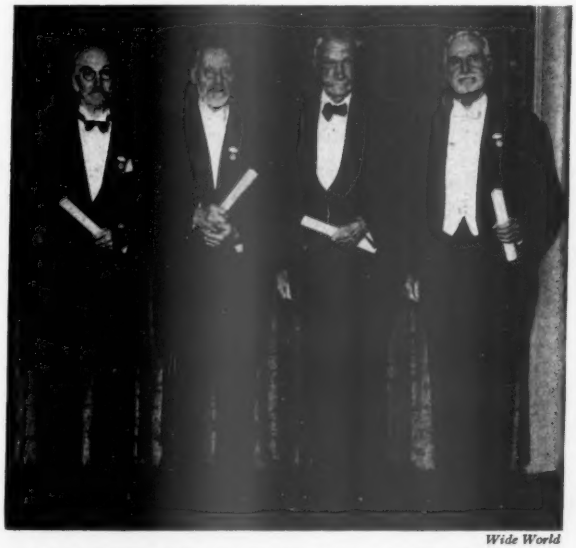
¶ Albert E. Wiggin, '07, to be Metallurgical Manager for the Montana plants of the Anaconda Copper Mining Company.

¶ William D. Milne, '08, to be Manager of the New England Division of the Eastern Underwriters Inspection Bureau, which position has been jointly held by Gorham Dana, '91, and Milton F. Jones, '94. Messrs. Dana and Jones, who have resigned as managers, remain with the organization.

¶ Robert Insley '19, to be Vice-President and Chief Engineer of the Continental Aircraft Engine Company.

¶ Arthur A. Blanchard, '98, Associate Professor of Inorganic Chemistry at Technology; Charles A. Kraus, '08, Professor of Chemistry at Brown University; and Miles S. Sherril, '99, Professor of Theoretical Chemistry at Technology; to be Visiting Lecturers at Harvard University.

In the Faculty there are to be one new full Professor, two new Associate Professors, and three new Assistant Professors. These appointments have been announced since the November Review together with the resignations of six members of the Faculty, (see page 97).



Wide World

LEFT TO RIGHT: JAMES W. NEILL, W. H. RADFORD, ROBERT H. RICHARDS, '68, AND HENRY D. HIBBARD, '77. IN OCTOBER THEY WERE PRESENTED WITH THE AMERICAN INSTITUTE OF MINING ENGINEERS' LEGION OF HONOR DIPLOMAS, DENOTING FIFTY YEARS OF MEMBERSHIP

Purchased

For the Boston Museum of Fine Arts, a sixteenth-century Gothic tapestry which used to hang in the private chapel of Knole, the Kemp residence of Lord Sackville; by Robert Treat Paine, 2nd, '81. Reported price $250,000.

Deaths

The Review is very happy to correct the erroneous report, received last month and published here, of the death of Frederick W. Swanton, '90. He is very much alive and actively at work in the Patent Office in Washington.

Since the last issue, reports have come to The Review of the decease of the following:

¶ Arthur W. Temple, '75, on October 17, 1927. He was in the real estate business in Reading, Mass. See the Class Notes for 1877.

¶ Walter Eugene Frost, '81, on June 24, 1928. Previous to his death he was a director of the Frost Coal Company in Dorchester, Mass.

¶ FREDERICK PRESCOTT KENDALL, '81, on March 23. His business interests in Portland, Ore., included the American Can Company of which he was general manager, and the Sanborn Cutting Company, of which he was Vice-President.

¶ FRANK TENNEY, '83, on October 5. Before his retirement he had been assistant to the Vice-President of the Bethlehem Steel Company.

¶ ALEXANDER HAMILTON TWOMBLY, '87, on June 26, after a long illness, at his home in Summit, N. J.

¶ CHARLES PORTER SMITH, '87, on July 14, after an illness of three weeks, at his home in Methuen, Mass.

¶ JAMES THORNTON GREELEY, '87, on August 29. He had been a physician and surgeon in Nashua, N. H.

¶ WALTER CLARK FISH, '87, on September 8. He had been works manager for the General Electric Company in Lynn, Mass.

¶ ROBERT WILSON BISSELL, '91, on January 18. Formerly he was general manager for the Pittsburgh Steel and Chemical Company.

¶ HARRY FAY ROACH, '93, on July 28. He was an architect, practising in St. Louis, Mo.

¶ STEPHEN LOVEJOY BREED, '93, on September 15. He was a lawyer and real estate dealer in Lynn, Mass.

¶ JOHN DOVE, '95, on August 4, at Litchfield, Conn.

¶ GEORGE SEWARD HUME, '99, on June 3. He was a member of S. B. Hume and Son of Eastport, Maine.

¶ REUBEN WILFRED BALCOM, '00, on October 17. Previous to his death he was principal chemist in charge of the food control division of the food, drugs, and insecticide administration of the United States Department of Agriculture of Washington, D. C.

¶ FREDERICK JAEGER, '09, on July 21. At the time of his death he was associated with the Naval Powder Factory at Indian Head, Md.

¶ MORRIS LEONARD CAUST, '18, on September 5. He had been a chemical engineer with Tileston and Hollingsworth Company of Boston.

¶ OLIVER VANPATTEN SMITH, '21, on October 1. He had been associated with the Gillette Safety Razor Company in Boston.

Elected

To be President of the Social Research Council, EDWIN B. WILSON, from 1917 to 1922 Head of the Institute's Department of Physics and now Professor of Vital Statistics in the Harvard School of Public Health.

Launched

The yacht *Reno* built for ALFRED P. SLOAN, JR., '95, President of the General Motors Corporation. The boat, which will cost approximately $1,000,000, is a steel twin screw cruising Diesel yacht, 236 feet long.

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VISITING COMMITTEE REPORT

Covering the Recent Meeting of the Visiting Committee for the Institute's Department of Biology and Public Health*

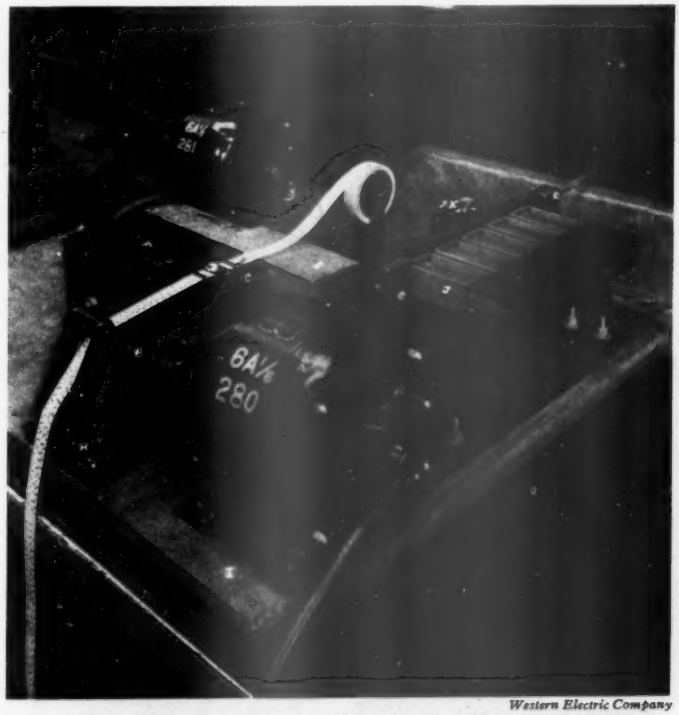
THE Department of Biology and Public Health has had a year of interesting development, characterized by enlarged registration in the undergraduate years, healthy increase in the graduate students, and greater opportunities to carry on research work of important character, both in pure science, and in cooperative effort with organizations seeking to improve or establish scientific work. From the standpoint of registration the Department is larger than ever before and all indications point to continued growth, and, if the demands and opportunities can be satisfactorily met, to increasing usefulness in the broadening fields.

Undergraduate Work. The work for undergraduates has continued in the two divisions or options of Public Health and Industrial Biology, although these are alike throughout the first two years. Through monthly staff meetings, the professional courses given in the Department have been thoroughly discussed as to content and method, and unified and coordinated in a gratifying degree and, as a result, special attention has been given to sound presentation of the fundamental principles of the biological sciences. It is the belief of the Department, and this belief is concurred in by your Committee, that the first two years should be devoted largely to general education, to basic courses in the sciences — chemistry, physics, and biology — to mathematics, and to English and economics. The students are then better able to attack their professional work with broader and more mature vision.

The so-called Public Health Option continues the insistence on what may be called fundamental biological subjects, coordinating these with the special applications needed in the public health laboratory, the various aspects of official health administration, and to sanitation and hygiene in industries employing many workers. This program is also especially well adapted as preparation of those who intend to enter medicine as a profession, and we believe should be given greater publicity in this respect.

The option in Industrial Biology requires a similar thoroughness in those branches of biology, bacteriology, and biochemistry which underlie the food, fishery, and fermentation industries, with concurrent courses in the technology of these industries. This division of the Department shows a healthy growth, and we are happy to say the graduates are meeting the approval of the industries employing them.

A new option in Public Health Engineering will be offered at the beginning of the next academic year, the purpose of which is to give a more comprehensive combination of work in biology, bacteriology, sanitation, and public health administration with engineering and thus to meet the requirements now being made for men who can enter administrative positions as state health engineers, the U. S. Public Health Service and in the service of the international organizations engaged in health work. We hope that this will attract a group of students who will look forward to administrative service, but the program is strong also in the essential engineering training required in such activities as water supply, milk pasteurization, sewage treatment, waste disposal, drainage, and mosquito extermination, and the many problems of the modern public health engineer.



Western Electric Company

RECORDING DEVICE FOR TIME STUDY USED WITH ASSEMBLY BENCH SHOWN ON TOP OF FOLLOWING PAGE. EACH TIME THE OPERATOR FINISHES AN ASSEMBLY IT IS AUTOMATICALLY REGISTERED BY A PERFORATION IN THE TAPE

Graduate and Research Work. It is very gratifying to report that the number of graduate students has been larger than usual. Four men have completed requirements for the Ph.D. degree during the past year. It is evident that the graduate work is on the increase, and special provision must shortly be made to give such students

*This Committee includes William H. Bovey, '94, Minneapolis; Dr. Francis H. Williams, '73, W. Cameron Forbes, and Payson Smith, all of Boston.

Western Electric Company

WORK TABLE IN SPECIAL TEST ROOM FOR STUDYING THE EFFECT OF REST PAUSES AND OTHER CHANGES IN WORKING CONDITIONS. THE TESTS ARE BEING CONDUCTED BY WESTERN ELECTRIC WITH A MEMBER OF THE DEPARTMENT'S TEACHING STAFF ACTING AS CONSULTANT

adequate room and facilities for their investigations. The Department has been especially fortunate in having space in the Infirmary allotted to it temporarily to provide for some of this work and for some of the industrial researches. Laboratories especially designed for uninterrupted research work are needed, and it is hoped will soon be available. More research assistants are also needed. With continued increase in students, it will also be imperative to have some enlargement of teaching staff in the very near future.

Sedgwick Memorial Laboratory. Plans have been drawn and preliminary steps taken to attempt to secure a new building as a memorial to Professor William T. Sedgwick, to whom the Department owes its prestige and who for nearly forty years was its devoted head. The departmental staff and committees of graduates are now working on plans to carry out this project, which it is hoped will receive cordial support from organizations and individuals of means who have an appreciation of Professor Sedgwick's personal service and that of the Department. The proposed plan involves a new building adequate to house the teaching research laboratories and an endowment which will guarantee the support of special teaching and of research work in pure as well as applied biology. If, as hoped, such a development is soon to become a reality, it will necessarily bring with its enlarged opportunities the demand for increase in staff, but it will also supply better coordination with related departments, improved teaching facilities and a great stimulation of investigation in many branches. These are matters to which careful thought is already being given by the Department.

Respectfully submitted,
WILLIAM H. BOVEY, '94, *Chairman*

M. I. T. Photo

IN THE DEPARTMENT'S BIOCINEMA LABORATORY — MOTION PICTURE CAMERA DESIGNED FOR TAKING FILMS OF MICROSCOPIC OBJECTS

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TERRACES AND TOWERS

(Continued from page 76)

conditions but a hundred stories is easily a structural possibility, and the Metropolitan Life Insurance Company has just announced that it expects to build one. Such a building would occupy a whole block and would contain within its vast body all of the functions of a small city, a veritable *urbs in aedificio*.

In so short a sketch of so vast a subject there is little space to discuss the unsolved problem of street congestion. Automobiles plus the population of the skyscrapers have converted our streets into human sluice ways. Raymond Hood suggests that all skyscrapers be isolated with sidewalk space entirely about them. The Frenchman, Le Corbusier, advises that the ground floor be partly open, the building resting on its columns as on stilts, exactly as is done now in buildings erected over air rights. Mustapha Kemal Pasha in his new capital at Angora proposes to build very wide through arteries on which buildings will not face and in which traffic can stop only at street intersections. The problem of traffic congestion is like the problem of the skyscraper thirty years ago and like it the solution will surely be found.

Cities are beginning to show stratums of high buildings. In Chicago we have the pre-war skyscrapers, about four hundred of them, with their boxlike forms and continuous cornices, and the post-war skyscrapers with their 250 foot walls and their towers above, and now we are promised or threatened with a super-skyscraper with perpendicular walls 400 feet in height and a tower rising to 700 feet and more above the pavement. New York in the Chanin Building with its fifty-six stories has already achieved the super-building. The Chrysler Building, under construction, will be 808 feet high, and as I write there is an announcement that the ex-governor of New York and champion of personal liberty is to head a syndicate which, on the site of the old Waldorf-Astoria Hotel, will erect a building eighty stories in height, over 1,000 feet, and costing $60,000,000. And there is the Metropolitan Life Building mentioned above. It is not alone in height that American architects are making this an age of architectural wonders. Study and money, as never before, are being lavished on the details. I know a building in which the elevator doors are modeled by Paul Manship and the color scheme determined by a famous painter. Lowly things like lighting fixtures have been born again and utterly revolutionized in form and beauty by the new art. New materials for walls, floors and ceilings have suddenly, almost mysteriously, appeared. Color, so long avoided, glows without and within.

The skyscrapers are the greatest works of architecture since the cathedrals of the Thirteenth Century. Those were called forth by the ecstasy of mediaeval faith. These are born of the fervor of business and science. Each was the inevitable and truthful creation of the genius of its time. The skyscrapers are truly cathedrals of commerce and they make the Thirteenth and Twentieth brothers among the centuries. But scorn them not because they spring from stocks and bonds instead of breviaries and missals. Whatever their origin, their structure was raised to those great heights with a crusader's courage and they are veiled with forms apocalyptic in their beauty.

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RESEARCH AND LABOR

(Continued from page 78)

tightening bolts; he was building automobiles, and they left the assembly line at the rate of four a minute. He had steady work, good pay, and his hours were not long. Upon the whole he would probably prefer it to the effort and monotony of turning a windlass to hoist ore as other men once did.

It is true, nevertheless, that there are many jobs at machine tending, where the worker has no responsibility for its control, which are demoralizing and deadening for the individual endowed with imagination and initiative. Not all workers, however, are so endowed. There are those who prefer repetitive work which they can easily learn, and which makes little or no demand upon mentality.

An instance comes to mind where there was a large monthly turnover of labor in an establishment in which the most effective workers remained indefinitely. A psychologist was called in who applied intelligence tests to the whole group. It then became evident that only the more intelligent workers were involved in the turnover, those of low intelligence being contented and happy in their work. The advice of the psychologist to the management in this particular instance was, therefore, "Select stupidity and train it."

Stuart Chase estimates that there may be in the United States 5,000,000 persons whose work is wholly dominated by the machine. That is less than five per cent of our population, or about thirteen per cent of those gainfully employed. I do not know the basis of his estimate, but it would seem as though the country could provide that small proportion of persons mentally qualified to find satisfaction in such jobs and badly handicapped for making a living otherwise.

THE IMPORTANCE and advantage of the proper mental and physical adjustment of the worker to his job are beginning to be recognized by science and management alike. His reactions under strain and the many factors affecting his well-being and efficiency are now the subjects of serious study by such agencies as the Industrial Fatigue Research Board and the National Institute of Industrial Psychology in England, the Psychological Institute of Paris, and other organizations and individuals in the United States. There, especial significance is attached to the comprehensive program of research recently undertaken by the School of Business Administration of Harvard University in conjunction with the Harvard Medical School.

For this research there has been organized a group of eminent physiologists, psychologists, medical specialists, and biochemists, who are endeavoring to investigate the human individual rather than a particular physiological mechanism. To this end they are proceeding to take as many as possible of the various measurements simultaneously, and they are thus beginning to arrive at some general understanding of the way in which the various organic functions supplement and compensate each other. Through this simultaneous study of the various organic changes which result from effort the laboratory has reached an important initial generalization, which is that "high production occurs if the worker's organism is kept at equilibrium when his *(Continued on page 108)*

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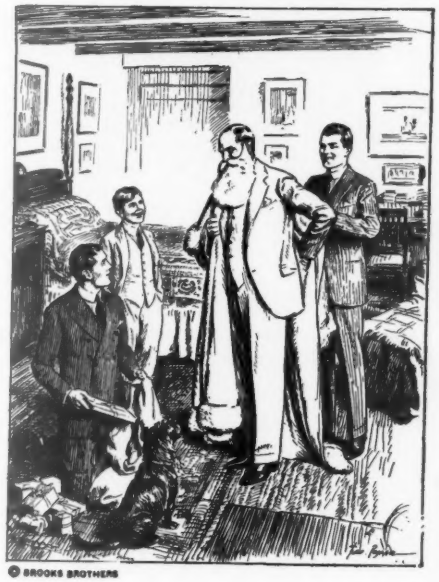

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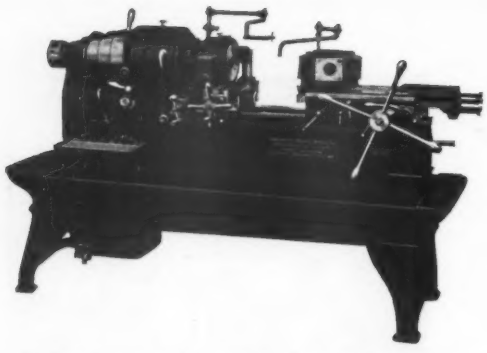

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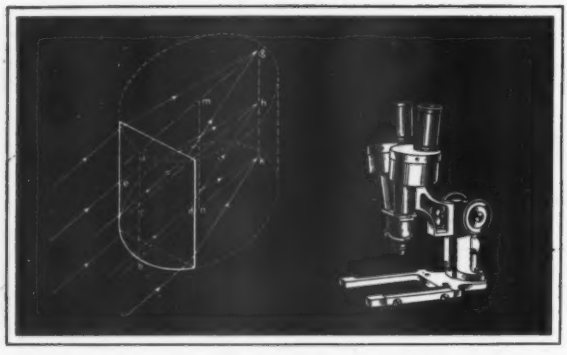

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RESEARCH AND LABOR

(Continued from page 106)

metabolic rate (his consumption of oxygen) is lifted." This gives a new conception of "work" and provides a first tentative indication of the way in which the happiness and content of mental equilibrium may be related to organic equilibrium or changes of organic balance.

Concurrently with the studies in the laboratory, investigations are going on into the preoccupations of the worker as developed not only by his job, but by his family and social environment.

We may reasonably expect that science, through its studies of the worker himself in all these aspects, will ultimately show the way to such better adjustment of the worker to the work as shall add greatly to his contentment and well-being.

FOR MANY YEARS manual workers entertained the fallacy that there is only so much work to be done in the world. Since its amount seemed to them hardly sufficient to keep them all employed, it appeared obvious that any device that enabled one man to do the work of two must deprive the second man of his job.

The typewriter undoubtedly displaced some copying clerks, but it provided employment for a far greater number of typists, led to the establishment of special schools, and provided jobs for thousands in factories for manufacturing the machines and their accessories of ribbons, carbon paper, stencils, and so on. The linotype, which enabled one man to do the work of six, reduced the hours of work from ten to eight and put wages up twenty per cent. It improved shop conditions and ensured greater regularity of employment. It eliminated the tramp printer, but ultimately provided more jobs and better jobs for workmen of a higher type.

The introduction of pneumatic tools like the riveter, drill, and stone chisel undoubtedly, for a time, deprived some men of work, but they so facilitated metal and stone work, the sinking of foundations, and the fabrication of steel structures that, in America at least, the volume of such work increased so rapidly that many more men soon found employment in the operation of these machines, while the making of the machines themselves became an important industry.

Knowledge is of two kinds, static and kinetic. Static knowledge may satisfy the individual, but only as knowledge becomes kinetic can the world's work be done. It becomes kinetic as it remolds men's minds or induces thought which leads to action, and it then finds, perhaps, its commonest expression in invention. Fortunately, a large proportion of the new knowledge acquired by the world through the incessant questioning of nature during the last hundred and fifty years has assumed the kinetic form, with the result that science has not only freed the mind of man from countless inhibitions and taboos, but has become, as indicated in the above examples, the most prolific creator of new jobs.

In considering the impact of science upon industry one's thoughts naturally first turn to electricity. We are within two years of the centenary of those pregnant discoveries of Faraday in the laboratory of the Royal Institution, which, for the first time, *(Continued on page 110)*

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RESEARCH AND LABOR

(Continued from page 108)

made possible the production of current by mechanical rotation. The earlier contributions of Volta, valuable and suggestive as they were, left us with no better source of current than the primary battery. Before Faraday there was nothing upon which to build even the beginning of an industry. Faraday furnished the fructifying idea which in the minds of Wheatstone, the Siemens, Gramme, and Pacinotti soon bore fruit as the dynamo. Upon this machine as its foundation has since been built the great superstructure of the electrical industry with its electric light, power, and traction companies, electrochemical plants, and the manufacturing companies which furnish a bewildering variety of electrical equipment, apparatus, and supplies.

In 1876 there appeared in America the Brush dynamo and his commercial system of arc lighting, and about 1880 Swan in England and Edison in the United States developed the incandescent lamp. In 1882 the Pearl Street Edison Station in New York turned on its current to light the 400 lamps of its eighty-five customers. One may point out by the way that these customers were charged 1.2 per cent per hour for a 16 candle-power lamp, whereas today one cent will buy 125 candle-power hours.

For a time the electrical industry was concerned almost exclusively with illumination. It extended its field to traction about 1890 and developed a ubiquitous, reticulated system of street and interurban railways. The year 1894 witnessed the installation at Niagara Falls of water-wheel generators of 5000 kilowatt capacity, and a diversified electrochemical industry grew up around them. In 1903 came the first 5000 kilowatt steam-turbine driven unit. Today such units are built of 208,000 kilowatt capacity, requiring two tons of coal and 400,000 gallons of condenser water every minute of operation.

Because of these developments, which found their creative impulse in the brain of Faraday, electricity is now a servant in 16,000,000 American homes, in many of which it condescends to wash and iron clothes, clean the carpets, cook, and fill the ice chest. It is rapidly reaching out to the rural districts to lighten the labor of the farmer and his wife.

In 1869 the power at the command of an American workman was six-tenths horsepower. Today it is four and one-fourth horsepower, the equivalent of fifty-five man power, and three-fourths of this is furnished by electricity.

In the absence of statistics I can only hope that your imagination may enable you to form some adequate conception of the multitudinous opportunities for employment which these developments have brought to labor. As a starting point, there is the fact that 300,000 men and women are employed in the 1700 establishments engaged in making electrical equipment. This has an annual value of one and one-half billion dollars and includes 500 million incandescent lamps.

This brief survey will have failed altogether of its purpose if it has not brought home the fact that with the world's growing population the only remedy for unemployment is research. Were it not for the millions of opportunities afforded workers in the enterprises based on the contributions of science in *(Continued on page 112)*

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Fairchild Photograph on Page 100

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RESEARCH AND LABOR

(Continued from page 110)

years within the memory of most of us, we should now be faced in the United States with an unemployment problem appalling in its magnitude and heart-rending in its results.

THE MANY EXCELLENT PERSONS who anticipate with horror the ultimate standardization of the world through mass production should realize that the field of mass production is very definitely limited and its extension subject to check by many factors. Powerful among them are the demands of style, the desire for individual expression in clothes and surroundings, and the purchases resulting from what Veblen calls "pecuniary emulation," which, in the American vernacular, means "keeping up with the Joneses." There are limits to the efficiency of centralized management, success invites competition, and, with expansion, costs of distribution mount. Standardized articles must necessarily be limited to those which many people want, that is, those which permit of national distribution.

Mass production is here to stay, however, and the charge that it is imcompatible with beauty cannot be lightly dismissed. Carried along in the flood of its output are many products deserving of a place nowhere but in a Museum of Bad Taste. That, however, is not the fault of the machine, but of the head, for the machine is as truly a tool of the head as the hand itself is. Though we have seemed, aesthetically, to be in danger of domination by the machine, we are beginning to prove ourselves its masters even in this relation. Many machine products are already better than the craftsman's best. Many others have their own distinctive beauty because of their perfect adaptation to their purpose. The proportion of both seems certain to increase. Whether it does or not, one must agree with Beard in his introduction to "Whither Mankind," that "those who are prepared to sacrifice the standard of living for the millions to provide conditions presumably favorable to the creative arts must assume a responsibility of the first magnitude."

But even in a machine age there is still hope for the creative arts. The machine is saving us much time. We produce, transport, and distribute the necessities of life with the expenditure of a small fraction of the time and effort required of our forefathers. The time cost of living has gone down. The machine is creating leisure, and we now need schools to instruct us in its use.

Recently there was held in Boston the second annual exhibition of paintings and sculpture by the members of the local Business Men's Art Club. It contained many examples of serious and meritorious work. There are, already, in the United States, about two hundred of such clubs. Why should not the operator of the machine similarly divert some portion of his new-found leisure from the movies and the comic strips to the creation of beautiful things and so regain the pride of craftsmanship and acquire leisure of soul?

We come, finally, to the charge that science, through the machine and mass production, has engulfed in materialism the civilization of the West.

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RESEARCH AND LABOR

(*Continued from page 112*)

immense spiritual values latent in the philosophy of the East, one cannot close his eyes to the conditions from which, in the absence of science, it has failed to free the long procession of generations numbering hundreds of millions each. In China, with its low level of poverty, millions still die of famine, though food may be abundant one hundred miles away. In India, other millions, in the grip of caste, are bound to their predetermined status, though it may condemn them to go through life untouchable and unclean. Let us then, before we adjudge our own civilization to be materialistic, weigh these words of Hu Shih, a scholarly and traveled Chinese:

"To me that civilization is materialistic which is limited by matter and incapable of transcending it; which feels itself powerless against its material environment and fails to make the full use of human intelligence for the conquest of nature and for the improvement of the conditions of man. . . .

"On the other hand, that civilization which makes the fullest possible use of human ingenuity and intelligence in search of truth in order to control nature and transform matter for the service of mankind, to liberate the human spirit from ignorance, superstition, and slavery to the forces of nature, and to reform social and political institutions for the benefit of the greatest number — such a civilization is highly idealistic and spiritual."

STEAM *vs* ELECTRICITY

(*Continued from page 81*)

required to construct the necessary power supply and distribution system and to procure the needed electric motive equipment and can with a reasonable degree of accuracy estimate the operating expenses under electric operation for the improved conditions for hauling the traffic which may be made available by electric motive power. These estimates, however, do not tell the whole story, since, for example, electrification may and normally should increase passenger traffic where the latter is of importance. Moreover, it is probable that traditional steam train schedules on any railroad ought to be radically changed to get the greatest benefit from the change from steam operation to electric operation. This applies to freight as well as to passenger service.

A special example of passenger traffic exists in suburban commuting service with multiple-unit cars that lend themselves to various economic numbers of cars per train to suit the traffic demands at different hours of the day. The quicker speeds and smoothness of operation of such trains compared with steam-powered trains in local service, serve as an attraction to riders who find automobiles and motor buses also available for their patronage. The possibilities of increasing commuting service during the "off-peak" day and evening hours by utilizing more frequent and shorter trains with moderate operating costs give multiple-unit trains additional advantages for suburban services. (*Concluded on page 116*)

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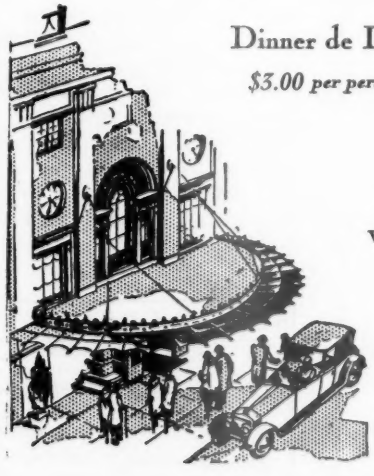

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STEAM *vs.* ELECTRICITY

(Continued from page 114)

Electric locomotive operation normally eliminates some locomotive weight from the train and secures a corresponding reduction in energy for the train movement, compared with steam operation for like service, or a corresponding increase in revenue tonnage may be hauled with equal total expenditure of energy. The saving in fuel consumed by embracing central station generation of energy instead of burning the fuel on steam locomotives secures a reduction in non-revenue freight haulage by an electrified railroad (*i.e.*, to the extent of the larger part of its own fuel) which also effects the release to a corresponding extent of freight cars and trackage capacity for revenue use. Electric locomotives of the best type are demonstrably capable of more continuous use than modern steam engines.

Although sometimes disputed, it is a clear fact that all transportation service done by steam engines may be as well accomplished by properly designed electric motive power, and in suitable situations at less operating cost. The shortcoming of railroad electrification is the first cost of installation which is high compared with steam motive power for most situations; and thus limits the economic applicability of railroad electrification in America to situations illustrated by the preceding discussion, and emphasized the importance of utilizing those electrical means which will produce the result with the most moderate first cost.

SCIENCE AND THE FRONT PAGE

(Continued from page 85)

the country's great communication laboratories brought forth the automatic printer or printer telegraph. Its possibilities for speeding-up the news seemed boundless. It employs a standard typewriter printing unit which transmits varied electrical impulses at the touch of the individual keys. Science thus succeeded in projecting the touch of the typist to type bars which might be in effect a thousand miles away.

Although in the course of time communication by Morse telegraphy had been quickened, notably through the Phillips' Code, an abbreviation of words and phrases compiled by a veteran press telegrapher, and the substitution of the vibrating bar of the "bug" or vibroplex for the old single lever brass key, automatic printer telegraphy spelled the doom of Morse (*Concluded on page 118*)

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SCIENCE AND THE FRONT PAGE

(Concluuded from page 116)

telegraphy for news transmission. Even with the "bug" and the Phillips' Code, the best a Morse operator could do was fifty to sixty words a minute for a short time in emergencies; while the automatic printer can pound along at better than sixty day in and day out.

Recently press associations have eliminated Morse wires for the transmission of stock market quotations. The printer telegraph has been adapted to deliver its messages on a gummed tape which is quickly cut and pasted on special stock report forms. (See picture on page 83.) Thus a last stronghold of the Morse men crumbles, and soon their metallic language and traditions will have passed into the oblivion of silence. For generations they have used the figure "30" to indicate the end — the end of a news story, the close of a day, the end of a life. But traditions mean little to the callow youths operating printer circuits and hence to the veteran of the Morse wire, accustomed to the sound of brass on brass with an old tobacco box for a sounding board, "30" takes on a new and unhappy significance.

With these products of science at hand, what is to prevent the issuance of a master newspaper in New York and transmitting it by wire and air, column by column, or page by page, to a thousand newspaper offices, there to be reproduced on the engraver's plate and quickly printed? Even metropolitan dailies might simplify their task by connecting in rotation to London, Paris, Rome, and the like, quickly switching to Paris, for example, if London's story didn't quite fill the column. This would be a new development of the oldtime "boilerplate" services with a vengeance!

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THE TABULAR VIEW

DR. NORBERT WIENER'S theses in his article "Mathematics and Art" may aptly be applied to himself, for his great gifts as a mathematician are obviously paralleled by a singularly acute apprehension of the fundamental aspects of beauty in all art. As Henri Poincaré (1854–1912) once wrote, "Above all, adepts find in mathematics delights analogous to those that paintings and music give. They admire the delicate harmony of numbers and of forms: they are amazed when a new discovery discloses for them an unlooked for perspective, and the joy they thus experience, has it not the aesthetic character although the senses take no part in it? Only the privileged few are called to enjoy it fully, but is it not so with all the noblest arts?" Dr. Wiener is one of the privileged few. He will be remembered by Review readers for his commentary on the mathematics of S. S. Van Dine's "Bishop Murder Case" in the March, 1929, issue and for his article "Einsteiniana" in the May, 1929, issue.

THOMAS C. DESMOND, '09, (A.B. *magna cum laude*, Harvard '08) who contributes "South America in 1929," is President of the New York firm of T. C. Desmond and Company, Engineers. In addition to his professional work, he has actively participated in public affairs: in 1916 he was national Treasurer of the Roosevelt Non-Partisan League; for many years he has been President of the New York Young Men's Republican Club; and in 1928 he was a delegate to the Republican National Convention. He has also been a member of various housing commissions and is at the present time a director of the Murray Hill Trust Company. His wide experience, therefore, enabled him during his South American trip to view with an observant and searching eye the social, economic, and political aspects of the Latin countries. ¶ JOHN R. FREEMAN, '76, has long been a leader in New England industrial life and he is internationally noted as an hydraulic engineer. His great ability is reflected in the four honorary Doctor of Science degrees which he has been awarded respectively by Brown, Tufts, *Sachs Technische Hochschule*, and the University of Pennsylvania. He assisted as a consultant in the construction of the Panama Canal, was in charge of the flood control developments on the Yellow River in China, and at present he is a member of the Engineering Council's Mississippi Flood Control Committee. He will be remembered for his article in The Review for December, 1927, entitled "Needed: More Science in Flood Control." The article in this issue is derived from the paper he presented at the World Engineering Congress meeting in Tokio during November, 1929.

ENGINEERING METHODS are most essential for the solution of complicated problems in industrial management. The Institute's Department of Economics, recognizing this, has initiated research work to evolve engineering and mathematical treatment of management problems in such a way that they can be applied by men in industry. The article on (*Continued on page 126*)

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THE TABULAR VIEW

(Concluded from page 125)

page 139 is a general exposition of one phase of this research: the determining of economic production quantities. Assistant Professor Fairfield E. Raymond, its author, has been engaged in this work for several years and has made significant contributions to the science of scheduling production. Professor Raymond received his Bachelor of Arts from Harvard in 1918 and his Bachelor of Science from the Institute in 1921. ¶ L. MAGRUDER PASSANO, Associate Professor of Mathematics at the Institute, is a frequent contributor to the department "Books." Those who have heard Professor Passano at the famous round table in the Institute's Faculty Dining Room will see reflected in his reviews his trenchant but withal merry observations on cabbages and kings. ¶ No recent book interpreting the meaning of modern science has conferred so much *éclat* upon its author as "The Nature of the Physical World" by ARTHUR S. EDDINGTON. Readers who found that book stimulating will be equally interested in an extension of it, "Science and the Unseen World." For a commentary on this DR. WIENER was again commandeered as the man best qualified to do the job. (*Vide supra.*)

THE COLOR REPRODUCTION on the cover was reproduced from a water color, "The Arch of Titus," executed by EDGAR I. WILLIAMS, '08, in 1914. It is in the possession of the Institute's Department of Architecture. Mr. Williams is a practising architect in New York and is exceptionally gifted as a water colorist. Another study of his will be reproduced on the cover of a subsequent issue.

EDITORIAL FILES in The Review Office are well stocked with contributions for succeeding issues. There will be a series of articles on the history of science, a fertile field that has never really been plowed adequately. Among these are an article on the development of the physical sciences in America by DR. JOSEPH MAYER and a fetching account of the career of Count Rumford by RICHARD W. HALE, '91. DONALD C. STOCKBARGER, '19, who contributed to the November, 1928, issue the now famous article "Check the Sun Bath," will be represented soon again by "Adventures in Radiation." From FREDERIC H. FAY, '93, has been obtained an abstract of an important and informative paper delivered by him before the American Society of Civil Engineers on the engineering development of Metropolitan Boston. ASA W. K. BILLINGS, JR., '26, will contribute an article on modern architecture, particularly that exemplified in Germany and Holland. There will also be articles on modern problems in ventilation, particularly on the possibility of scientifically ventilating and humidifying the small home. These will be followed by a paper on the contributions of science and engineering to domestic comfort.